THE LOOSE GEARS

Issue III | Storming Robots' Student Publication | Dec, 2011

Storming Students as Finalist at the MIT/NASA SPHERE Tournament

Storming Robots Competes in an MIT Competition

-By Nikhil Shah

Storming Robots participates in many different competitions. One of the most notable is Zero Robotics hosted by MIT, in collaboration with NASA.

A quote from the MIT's ZeroRobotics' site – "… it is a student competition that takes "arena robotics" to new heights, literally. The robots are miniature satellites called SPHERES, The final competition of every tournament is aboard the International Space Station!". SPHERES stands for Synchronized Position Hold, Engage, Reorient, Experimental Satellites. Each satellite contains its own power, propulsion, and computing and navigation equipment.

Courtesy from zerorobotics.mit.edu

This competition is an intensively physics/programming centric challenge where the teams design software to automate small satellites.

The objective of the challenge is to score as many points as possible. The primary way to earn points is for the simulated satellites to mine two digital asteroids for Helium-3. Each team's program must run simultaneously with another team's. They can choose to collaborate or compete against one another. With collaboration, both of the teams will score more points.

The Storming Robots team consists of Matthew Goldman, Avery Katko, Ben Brown, Matthew Sicotte, and Nikhil Shah, myself. The team is named, The Defending Champions, to create humor, since in reality, they are not the defending champions of the competition.

The Defending Champions have been working on this project since September 2011. Since then, they have made it all the way to the semi-finals.

During the competition, the team worked to score as many points as possible and pursued a strategy of communicating with other teams. The IDE allowed for messages to be sent between the satellites. Avery, Matthew Sicotte, and Matthew Goldman all agree that dealing with the communication was the most challenging part of the entire project.

The competition schedule has been very intensive. Programs were required to be submitted twice in October to run in simulated competitions. It was then followed by an elimination round in early November. The top fifty-four teams

Photo from each individual student

Team Picture: (from left) Avery Katko -17-HomeSchool, Matthew Goldman-17-Bernardsville HS, Matthew Sicotte-16-Somerville HS; Nikhil Shah-16-Ridge HS; Ben Brown-16-Gill St. Bernard HS.

were advanced to the Semi-Final Round where they formed into alliance teams of three teams each.

The Defending Champions' alliance teams are from Houston/ Texas and Clarksville/Maryland. The goal is to collaborate in creating a single program with two other teams to submit to MIT.

Within the last three weeks of November, the teams have

Courtesy from the Space System Laboratory/ssl.mit.edu

diligently engaged in productive discussion for more math, coding and strategy enhancement using Storming Robots' internal online forum as the main media for communication. On December 2nd, the alliance team then again submitted code for another elimination round. The top 9 alliance teams were selected to enter the ISS Final.

In the final competition, our alliance program will run a bowling ball-sized spherical satellite inside the International Space Station's cabin. An astronaut will run the final robotics competition aboard the ISS and will interact with participating students via a live video broadcast at MIT.

"… Take robotics competition to new heights, literally - running miniature satellites (the robot) aboard the International Space Station! …"

The spheres which programs will be uploaded to compete at the ISS on January 23rd of 2012. Photo Courtesy from the Space System Laboratory/ ssl.mit.edu

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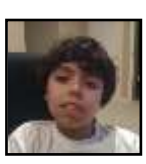

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THE LOOSE GEARS

Any accomplishments, robotics creations, and letters are welcome. Send your articles and stories to admin@stormingrobots.com to obtain details.

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THE INSIDE NEWS...

Storming Robots at the F.I.R.S.T. LEGO League

-By Tanya Glushkova

The F.I.R.S.T. LEGO® League (FLL) is a robotics competition where teams of students, ages nine through fourteen, compete in several segments of competition. FIRST stands for For Inspiration, and Recognition of Science and Technology. The goal of FLL is to let students program a robot, as well as offer solutions to real world problems. Each year FLL introduces a new theme that the competition will be about. Past years have included Body Forward (dealing with the Bio-Medical Engineering, especially in Nano Technology aspect), Climate Connections (dealing with climate issues), and Mission Mars (dealing with rover simulations). This year the theme is Food Factor Challenge. This will deal mostly with the problem of keeping food safe for long periods of time and avoiding contamination.

All teams will have to work together for two major parts of the competition. For the first part, they will have to build and program a robot that follows a certain track avoiding obstacles and solving challenges on the way. There are about 10 to 15 apparatus on the field, and mostly are accomplished based on motors rotations (using the encoders). There are a few lines on the field to allow simple level of self-awareness implementation with light or color sensors; or Ultrasonic sensor to detect obstacle.

For the second part, the teams will have to research the theme and present a creative presentation to a panel of judges about their findings. This year, SR has assisted three rookie teams at the competition: The Noisy Boys, Super Bot, and Storm 3. The Noisy Boys and SuperBot Teams advanced to the State Tournament.. In order to be qualified, teams have to score 50% or above on all four categories of the competition, Teamwork, Research/Presentation, Robot Design/Programming, Robot Field Game.

The teams worked very hard between September (some since August) and December to design, build and program their robots.

The competition is a very fun experience for everyone involved.

"My favorite thing about FLL was probably the research aspect of the competition. When we were doing research, we learned some pretty cool facts, about nanotechnology and food contamination," Janathan, from Noisy Boys, said. When asked whether he would participate next year he said, "Yes I would, for many reasons. First of all, there's always a chance to gain more experience and a great way is by participating in FLL. Competing in FLL is VERY fun. In FIRST, you have fun, as well as gaining knowledge."

The theme for 2012 has already been revealed as "Senior Solutions." The First Lego League explained the challenge "will explore the topic of aging and how it may affect a person's ability to maintain his or her lifestyle – solving issues like getting around, keeping in touch, or staying fit."

Noisy Boys posing in front of their presentation posters.

(From Left) Janathan Zhao, John Peter Battikha, Vishnu Pathmanaban, Sean Doran, and Andrew Chen

Super Bot's members (all 3rd graders): (From left) Hugh Zhang, Howard Hua, and John. Kapustka

TRENDING TECHNOLOGY...

Review of the book *"Googled"*

-By Nikhil Shah

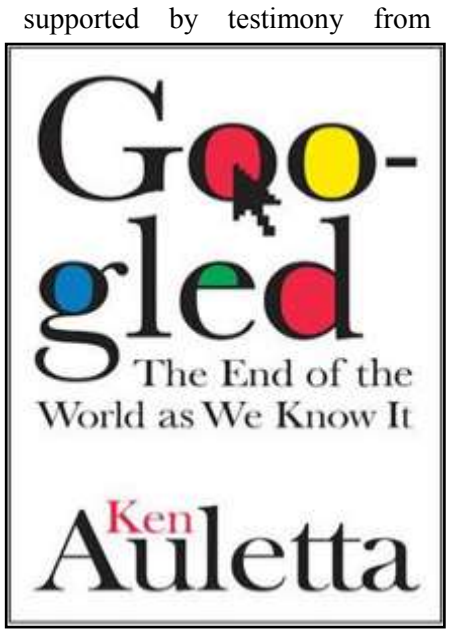
Book: Googled

Author: Ken Auletta
My Rating: 4.5/5

Google is an amazing company. Its changes to web search, e-mail, and the web browser have revolutionized and the world. Google is just as innovative and interesting on the inside as it is on the outside. *Googled*, by Ken Auletta, gives its readers an inside view of Google, and its influence on today's world, in particular, the media.

The story of Google and its founders is intriguing. We see how the founders of Google, Sergey Brin and Larry Page, created a corporation that relied solely on facts and data; there was no value in "following your instinct".

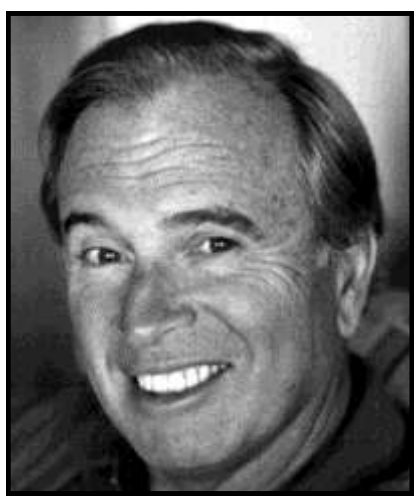
However, what differentiates *Googled* from other books about the company is the extremely thorough amount of background research that went into this. While reading, it felt as if every statement was being supported by testimony from someone. Whether it was a comment from a Google employee, an investor, or an executive from a media company, there was always someone backing up Auletta's ideas. The quotes were not intrusive, but perfectly depicted how Google operated and changed the media industry. They reveal a detailed story about Google by telling the reader things like how the slogan, "Don't be evil" was created, and how Google radically transformed the advertising industry by finding a way to quantify an advertisement's success.



Googled Cover. www.kenaultetta.com

The only reason why this book didn't get a perfect five out of five is that some of the stories about other companies could become slightly distracting from the main story. However, all in all, reading it is a wonderful experience..

(Special note: There are a few instances of strong language in the book.)



Ken Auletta, the author of *Googled.*

Photo: http://www.newyorker.com

The Future of Speech Recognition

-By Nikhil Shah

The first attempt at speech recognition was in 1952 at Bell Labs. This attempt was very basic, and paled in comparison to what was about to come. Fast-forward to today and speech recognition has not only become an integral part of consumer electronics, but also has become practical. In Google's mobile operating system, Android, speech recognition can be used to perform tasks such as searching the Internet, or composing an SMS message (Short Message Service). SMS messaging allows for short text messages to be sent from one cell phone to another. These features are very useful for people who don't like "fiddling" with small keyboards.

On Tuesday, October 4, 2011, Apple Inc. took voice recognition another step forward. Instead of having to memorize a given syntax, voice recognition software will identify the meaning of the words spoken by the user. For example, the user does not have to actually memorize the phrase, "What is the weather in New York City" in order to get the weather forecast, but can say, "Do I need to wear an umbrella today?" Apple is marketing this feature as a personal assistant "living" in the phone that helps with daily tasks. The speech recognition on the phone, named Siri, is going to be released as beta software, as Apple will continue to make improvements.

Www.apple.com

This latest technology was originally developed by SRI International; which was then bought out by Apple Inc. Thus, this nifty virtual, personal assistant has been known as the "Siri".

Siri could mark another major step forward in the way human beings interact with their technology products. Voice control could be in almost every single consumer electronic device. Instead of dealing with complicated user interfaces, people may one day have "conversations" with their phones and other devices asking for tasks to be performed. Who knows, perhaps someday people may simply ask one of their devices, "Could you please do my taxes?"

Google — the speech recognition feature. http://www.google.com

BELIEVE IT OR NOT...

The Fastest Thing in the Universe

-By Nikhil Shah

If you ask someone what the fastest thing in the universe is, you'll probably *get* the answer "light". For a long time, physicists accepted this as the answer. Recently, however, this fact has come into question. According to Popular Science, Scientists at CERN in Geneva, and the Gran Sasso laboratory in Italy have conducted some experiments and have come up with some very interesting results. They have observed that neutrinos, which small, subatomic particles with no charge and virtually no mass, are travelling faster than the speed of light! If the data from this experiment is widely accepted as fact, then this information will cause drastic changes on modern physics and Einstein's theory of relativity

CERN. www.nytimes.com

Popular Science reported that this data came from a standard experiment conducted between the CERN scientists and scientists at Italy's Gran Sasso laboratory. Neutrinos were sent from the CERN laboratory to the Gran Sasso laboratory to see how frequently the neutrinos change "types". The "types" refer to the different form of neutrinos. In this case, the neutrinos were being sent from CERN as a type named muon neutrinos, and some were received as another type, called tau. When the neutrinos reached Gran Sasso, the scientists noticed something interesting. The neutrinos arrived at the laboratory just nanoseconds before light could have. Now, 15,000 trials later, the scientists have reported that this has happened so many times that the only reason that this has not become accepted as a fact is because it would contradict one of the most widely accepted rules of physics, which is that the speed of light is the fastest thing in the universe.

Quasi-crystals and Nobel Prize

-By Nikhil Shah

On October 5, 2011, Dan Shechtman won the Nobel Prize for Chemistry. He was awarded this honor for his work with quasicrystals. Interestingly enough, PBS reports that he found these substances a long time ago, yet it took a long time for them to be accepted for what they were. Shechtman first discovered the crystals back in 1982 on April 8.

He was in his laboratory and he analyzed an alloy of aluminum and manganese that had been melted into a mixture and then rapidly chilled. Looking at the alloy through his microscope, New Scientists writes that he noticed something interesting; instead of seeing a random mix of atoms, he saw what appeared to be an organized shape, with a pattern that never repeated exactly, but was extremely similar. This was unheard of in chemistry.

Dan Shechtman

www.nobelprize.org

These results were extremely controversial. People refused to believe Shechtman and thought he had made a major mistake. This happened to such an extent that New Scientist says that Shechtman's boss actually asked him to leave the laboratory.

Later on, according to New Scientist, the quasicrystals' pattern was matched up with the pattern called Penrose tiles. This is a pattern where a plane is covered with a design that repeats almost exactly, but not quite periodically.

Eventually, quasicrystals became more accepted and the International Union of Crystallography changed the definition of crystals to incorporate Dan Shechtman's discovery. They said that a crystal had to have a "discrete diffraction diagram". This means that the crystals did not have to repeat in an exact, orderly fashion.

Mabel:

The world's fastest two-legged robot

-By Michelle Lu

The robot Mabel is a two-legged robot with knees. She is the fastest robot in the world with knees, with the ability to run as fast as 6.8 miles per hour. She runs around on her legs and has knees just like a human. Developed by Jessy Grizzle, professor in the Department of Electrical Engineering at the University of Michigan, Mabel can run fast relatively gracefully. Her feet are lifted high in the air (higher than most two-legged robots) for 40% of each step, modeling a real human runner.

Every since Mabel was built, University of Michigan students Koushil Sreenath, Hae-Won Park and Alireza Ramezani have been working on designs to smooth out Mabel's ability to run and walk, and working on her ability to run on bumpier, more uneven terrain. Using very complicated algorithms, the students are able to create a precise and tuned feedback control system that makes Mabel very energy efficient as well as accurate

Mabel runs at 6.8 miles per hour
http://tourwestern.com

when she walks or runs.

Basically, what a feedback control system does is to make sure that a system is reaching the desired goal by constantly adjusting inputs when the system seems to be going off in weird directions. The feedback controller in Mabel is constantly making thousands of little adjustments per second to make sure she doesn't fall over and moves forward. This system is based on an important model: it is used to figure out the best relationship between the robot's center of gravity and the motion of the other joints.

Mabel was created to replicate a human's weight distribution, and even has little springs that act like tendons in humans. These springs do two things. One: they are shock absorbers when Mabel's legs hit the ground, absorbing the shock of impact and making each step gentler. Two: they store energy for Mabel to release in her next step. Mabel weighs about 143 pounds, but most of the weight is on her upper body, which frees her legs to move more quickly forward and backward.

Advances in robotic technology such as Mabel marks a step toward the time when we can have robots that can move independently just like us!

Mabel is walking like a human!
www.onqpl. blogspot.com

AlphaDog: The New Military Robot Dog

-By Michelle Lu

Boston Dynamics has revealed its newest military combat robot, AlphaDog, which was created and funded by DARPA and the US Marine Crops. An MIT spinoff, Boston Dynamics teamed up with engineers and scientists from all kinds of outside groups such as Bell Helicopter, AAI Corporation, Boston Dynamics, Carnegie Mellon, the Jet Propulsion Laboratory and Woodward HRT.

AlphaDog, once completely ready for combat, can carry up to 400 pounds of equipment for 20 miles with refueling, and will also navigate through rough terrain conditions. Additionally, the robot does not need a driver. Using its GPS, computer vision, and hydraulics system, it automatically follows along with troops.

AlphaDog: The New Military Robot Dog continues…

The company president of Boston Dynamics, Marc Railbert, said, "If AlphaDog can offload 50 pounds from the back of each soldier in a squad, it will reduce warfighter injuries and fatigue and increase the combat effectiveness of our troops. "

AlphaDog stands on four legs, like an animal's, and has mechanical elements that help it absorb shock, be energy efficient, and be quieter when it moves. So far, AlphaDog is getting rave reviews not only because of its ability to smoothly navigate around large or small rocks and logs on uneven terrain, but also its ability to stay on balance no matter how hard it is shoved around by testers.

When AlphaDog is officially

Alpha dog walks smoothly on flat ground
http://homepost.kpbs.org

released to be used by the military in 2012, DARPA and the military will put the robot through actual simulations and tests. AlphaDog can really make a difference in our military, and keeping our country safer.

Revolution of Robotic Fish

-By Michelle Lu

Scientists at Michigan State University are designing, creating, and studying robotic fish that could possibly swim in schools and be released in natural environments to monitor environmental signs such as accumulations of algae or oil spills. Xiabo Tan, an assistant professor of electrical and computer engineering, and his team hope to create autonomous robot fish that can swim together in schools and navigate around obstacles without any human intervention.

Through the use of high-tech sensors and wireless capabilities, these fish can be released and can travel in water to collect information. People may ask, why use robotic fish when you can use other underwater devices to gather information? However, researchers working with fish robotics reply that fish are important to simulate because they behave in ways that other underwater devices cannot match.

First, fish are very energy efficient. They are agile and fast when changing direction and maneuvering in the water. Second, robotic fish can be directed where they are supposed to go and they can guide themselves to their destination, unlike other devices that nee5d continuous demands from human controllers.

The robotic fish that is being created at the University of Michigan was unveiled at a major event, where spectators watched an aquarium full of the robotic fish swimming around.

These cute robotic fish will help save a real fish's environment!
http://reefbuilders.com

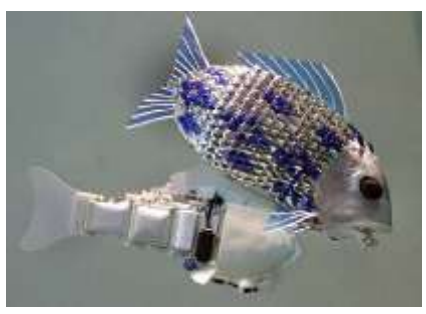
These fish are made out of electro active polymers that move in response to electric stimuli. The fish fins are mostly made of this material. These polymers change in size or shape when stimulated by an electric field. There are also artificial muscles in binding strips, put together in sheets, so that these fish's fins can be flexible and can bend, curl, and twist.

These robotic fish could potentially be very important in environmental research. They have the potential to collect valuable,

Robotic fish are being developed in many forms and sizes.

detailed information for researchers studying the effect of climate change and other forces on water and land ecosystems. For example, these fish could monitor oxygen levels, salinity, or public safety data. The researchers in this project hope to send their robotic fish to the Gulf of Mexico next year.

These robotic fish can



A robotic fish, with and without its scales.
http://www.robaid.com

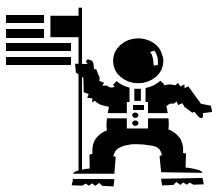
ultimately be a huge factor in aiding researchers trying to preserve fragile ecosystems.

Aeronautical Engineering

-By Tanay Trivedi

- Edited by Nikhil Shah

One of the most promising fields of engineering is astro-, or aero-, nautical engineering. Both are under Aerospace Engineering discipline. These fields are related to the design, construction, and science of aircraft, flying craft, spacecraft, and rockets, etc.



Our civilization is highly interested in exploring the universe and expanding our understanding of the worlds and galaxies around us. We have had much zeal in such exploration as the Space Race in the Cold War reminds us. From that time, space exploration has been accredited with improving foreign relations, increasing military power and expanding a region of science that is most interesting and motivating to young scientists.

How do young men and women learn to engage in this dazzling new field of science? Well, let's go through the steps of becoming an aeronautical engineer.

According to the online Resources for Math Information—

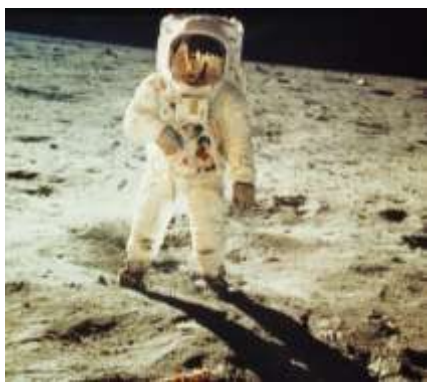
http://mathmajor.org/careers/aerospace-engineer/:

"Education: Aerospace engineers generally have a strong foundation in mathematics and physics; and require a degree in aerospace or aeronautical engineering. Aerospace engineering can also be studied at the graduate and post-grad level at many universities.

http://www.ehow.com/info_7924894_schools-aeronautical-engineering.html

Math Requirements: College Algebra, Geometry, Trigonometry, Calculus I and II, Multivariable Calculus, Linear Algebra, Differential Equations, Mathematical Modeling, Probability and Statistics. Addition recommended coursework includes Computer Science, Physics, Chemistry and Electrical Engineering.

When Aerospace Engineers Use Math: Like all engineering, mathematics is a crucial component to the job. Aerospace engineers use math to quantify components such as drag, stability, effects of temperature changes, as well as calculate forces from pressure, acceleration and inertia. They also deal with fluid dynamics, flight dynamics and create advanced mathematical models using complex computer software."



When choosing colleges, look for the kind that supports engineering and science in general like Carnegie Mellon and MIT. Then, narrow your search to aeronautics and astronautics. The schools that are most prominent are Georgia Tech, Purdue University and Penn State. As with most scientific and engineering jobs, the companies are on the lookout for the best and brightest through those top colleges mentioned above. A student can place a high category job with little education in college, says the Bureau of Labor Statistics. However, to receive promotions and rise through the ranks in the field, higher education in the Master's category is required.

More and more often do we hear of rovers and rockets going to Mars, Venus and many other planets in our Solar System. The thing people don't realize this is just in the name of science. Our planet will be overpopulated in a matter of years. Space missions themselves take many years to launch, complete missions and come back, not to mention it takes years to start preparations.

Thus, the government should be on the lookout for new ideas and engineers, right? The truth is that NASA will be out of business in a matter of years. Space exploration is now being more and more handed over to private industries, just like virtually all other government funded science administrations. Thus, companies, who are funded by the government, will scour top colleges for new and innovative engineers. The crux of it is that if you're very studious and stand out from your fellow competitors in college,

you'll probably get picked up pretty fast. Companies like Virgin Galactic and SpaceX have created lower-cost and space worthy crafts that can fly circles around NASA's technology.

They need better and better engineers to think of better and better ideas. This job can literally save the world. If private companies can get the jump on inhabitable planets, then we can save humanity from going the way of the dodo. It is important that people increase interest and investment in this industry. If the companies can get more funding, then they can get rolling on the idea of inhabiting other planets. The benefits are massive.

The Online Resource for Math Information —Aerospace Engineering Requirement

As this job relies on projects, like most other engineering jobs, the bonuses can be regular and immense. The income of a starting engineer would be from $60K to $140K, indicated at Payscale.com, or http://mathmajor.org/careers/aerospace-engineer/.

Overall, I think this field of engineering is one that should seriously be considered by the mass of science and engineering students graduating from high school and entering the world of space. The people who take these jobs can save humanity and advance our understanding of the galaxy and universe altogether. It allows for much acceleration through the ranks and for large project bonuses. On the whole, on the job scale of one to ten, I would definitely give this career a 9, considering the much growth and impact it has on humanity and the world as a whole.

Photo courtesy from aerospace.sdsu.edu

The LCD Program

- By Tanya Glushkova

The digits in LCD form
www..markinns.com

Q: What is the LCD Program and how do you use it?

A: LCD stands for Liquid Crystal Display. It is what one would see on a digital clock. The numbers 0-9 are written as a series of spaces, strokes, and underscores, and then grouped together to form larger numbers. This program requires basic knowledge of C/C++ and introduces the concept of an array data structure.

The first step is to understand that LCD numbers are formed by using either a space, stroke, or underscore in a "theoretical" 3x3 array for each digit; where each segment is assigned a number for convenience. However, for efficiency purpose, you will not want to create ten 3x3 arrays. Instead, a 10x9 array structure is used. The array's dimension is 10x9 because the goal is to print 10 digits (0-9) and there are 9 possible segments that the numbers are formed from

The first step is to assign each action (space, stroke, score) a short name , or called Macro, (e.g. sp,st,sc) and defining them in the beginning of the code like this:

```
#define sp  ' '
#define st  '|'
```

The next step is to build the actual array that will contain the numbers. For example, the following shows the initialization for '0 ,and '1':

```
char display[10][9]=
{ {sp,sc,sp,st,sp,st,st,sc,st},
  {sp,sc,sp,st,sp,st,st,sc,st},
  . . .
}
```

For this program, three variables, and several nested loops are needed. First the user is prompted to enter a digit, and this digit's value is saved (let's call it "value") . When referencing the array later, "value" will be the row number. The first loop will be in charge of placing a new line character into the array every three characters:

```
for(ct1 = 0; ct1 < 3; ct1++)
{ ...
  If ( ct1%3==0) printf("\n");
```

Then there will be a second loop, nested inside the first, to print all the characters from the appropriate row of the array. Recall that "value" was the row number to used:

```
for(ct2=0; ct2<3; ct2++)
{ ...
  printf("%c",
      digitDisplay[value][ct2]);
}
```

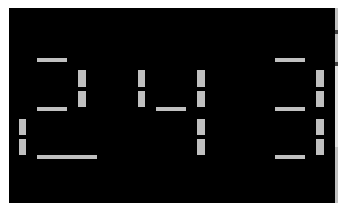
Now, if the formation of all digits look correct, modify the program to prompt the user for number, such as "891", and then print the digit in LCD form in a single row.

Here is the code fragment to display:

```
// assuming char input[] has "243"

int numDigits = strlen(input);
for (ct1=0; ct1<3; ++ct1)
{   printf("\n");
   for (i=0; i<numDigits; i++)
   {   n = input[i] - '0';
       ct2 = ct1*3;
       printf("%c%c%c ",
            digits[n][ct2],
            digits[n][ct2+1],
            digits[n][ct2+2] );
   }
}
```

Output will look similar to the following:



Now, why don't you try to write a program to display a string of words in digital form as well?

The alphabet displayed in LCD form.
http://www.earthshineelectronics.com

Remote Control with Touch sensors

- by Nikhil Shah

A remote control is a device that controls other devices from a distance. People generally associate remote controls with televisions. However, they have many more applications, such as a remote control robot. This is one of the most elementary projects done in our roboclub. If you have been at Storming Robots Roboclub for more than 2-3 terms, you may have had at least the simplest form remote control robotics project using the three touch sensors. There is a simple algorithm to create a remote control using touch sensors; the algorithm relies on nested-if -statements programming structure".

The program must ask if each touch sensor is pressed or released, and based on this combination, the program will perform a task.

If you are using the graphical user-interface language Robolab, the flowchart diagram below will be one of the best design method; as the programming language structure simulates the flowchart design layout.

For simplicity purpose, this diagram indicates the logic flow for only using two touch sensors.

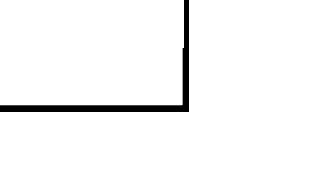
As this diagram indicates, the program involves nested-if structure, i.e. "ask" if sensor #1 has been pressed, then followed by another "ask" if sensor # 2 is pressed. After that, it determines the proper behavior. In this example, the program can execute four individual tasks/behaviors as follow:

Task 1: if T1 and T2 are pressed, perform action A .

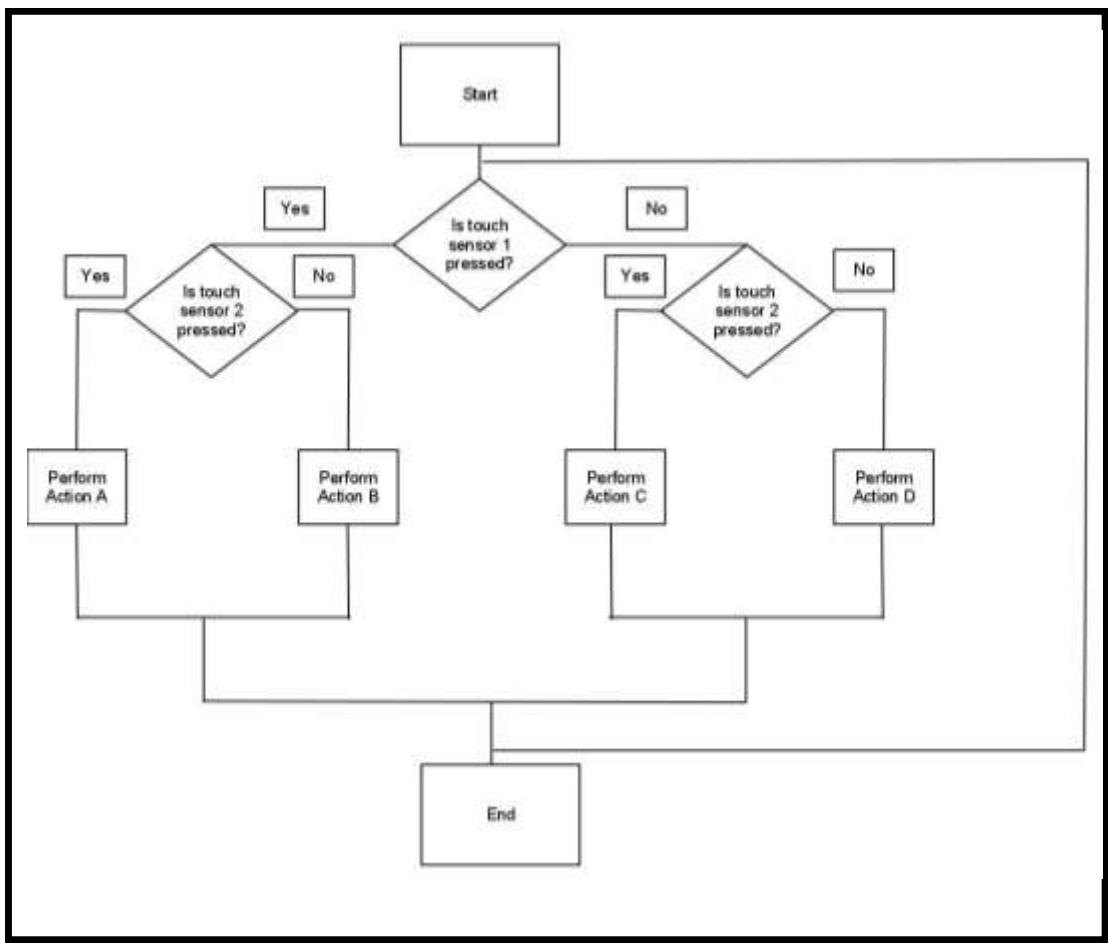
Task 2: if T1 is pressed, but T2 is not pressed, perform action B.

Task 3; if T1 is not pressed, but T2 is pressed, perform action C.

Task 4: if nether is pressed, perform action D.



Program the three touch sensors as the controlling device.



Remote Control with Touch sensors continues …

If you decide to write this in text-baesd language such as RobotC. , the best way perhaps is to use a "state table". The following is from Elizabeth Mabrey, the Director/Instructor :

State Table for this RC algorithm for a bot with 2 motors

T# where T= Touch sensor, # = input port number
T1 : control Left motor only
T2 : serves as logic state switch for different set of motions
T3 : control Right motor only

Action		T1	T2	T3
X = stop →= forward ← = backward		0 = off/release 1 = on/press		
1	All motors X	0	0	0
2	Right→ Left X; i.e. left drag turn	0	0	1
3	Left→ Right X; i.e. right drag turn	1	0	0
4	Both→ ; i.e. forward	1	0	1
5	Both← ; i.e. backup	0	1	0
6	Right→ Left←; i.e. left pivot turn	0	1	1
7	Left→ Right←; i.e. right pivot turn	1	1	0
8	Anything else you choose.	1	1	1

If you have a third motor to control an end effector like a claw, you will need to redesign the table slightly. E.g. eliminating drag turn, but installing 2 new actions for the claw.

Changes to the State Table to add in an end effector Connected to a 3rd motor

T2 : serves as logic state switch to control the end-effector

Action		T1	T2	T3
2	Right→ Left←; i.e. left pivot turn	0	0	1
3	Left→ Right←; i.e. right pivot turn	1	0	0
6	claw motor→; i.e. close claw	0	1	1
7	claw motor←; i.e. open claw	1	1	0

When it comes to programming it, utilizing the bits –operation to optimize the performance is a lot of fun to play with. The following is a code fragment to perform similar actions stated in the table with the end effector above.

```
#define T3ONLY  0X1
#define T2ONLY  0X1<<1
#define T1ONLY  0X1<<2
#define T1T2    T1ONLY | T2ONLY
#define T1T3    T1ONLY | T3ONLY
#define T2T3    T2ONLY | T3ONLY
#define NONE    0
#define ALL     T1ONLY | T2ONLY | T3ONLY

#define BW -100
#define FW 100
#define CFW 50
#define CBW -50
#define LM  motorA
#define CL  motorB // CLAW
#define RM motorC

#define GOFW  { motor[LM]=FW; motor[RM]=FW; }
#define BKUP   { motor[LM]=BW; motor[RM]=BW;}
#define LTURN  { motor[LM]=BW; motor[RM]=FW; }
#define RTURN { motor[LM]=FW; motor[RM]=BW; }
#define WSTOP { motor[LM]=0;motor[RM]=0;}
#define ASTOP { motor[LM]=0;motor[RM]=0;motor[CL]=0;}
#define CLAWCLOSE { motor[CL]=CBW; WSTOP; }
#define CLAWOPEN  { motor[CL]=CFW; WSTOP; }
#define UNDECIDED { ASTOP; PlaySound(soundBeepBeep);}

. . .
  result = SensorValue[S1]<<2 | SensorValue[S2]<<1 |
           SensorValue[S3];
. . .
  switch (result)
  {
        case T2ONLY:
              BAKUP;
              break;
        case T1ONLY:
              RTURN;
              break;
        case T3ONLY:
              LTURN;
              break;
```

```
    case T1T3:
          GOFW;
          break;
    case NONE:
          ASTOP;
          break;
    case T1T2:
          CLAWOPEN;
          break;
    Case T2T3;
          CLAWCLOSE;
          break;
    default:
          nxtDisplayString(5, "Invalid!!...");
          break;
    }
```

Note:

If you happen to run out of combination, you can use just utilize the flip bit method for the claw. For example: if only T2 is on, instead of wheels going backward, claw may open or close like the following:

```
. . .
bool open = 1;

case T2ONLY:
    while ( result == T2ONLY)
    if (open==1)
        CLAWCLOSE;
    else
        CLAWOPEN;
    nxtDisplayString(5, "Claw just %s",
        "open==1 ? "Closed" : "Opened");
    open = open ^ 1;
    nxtDisplayString(6, "next press will %s",
        "open==1 ? "closed" : "open");

   wait1Msec(5);
```

Greedy Algorithm

- by Matthew Sicotte

This summer, I encountered a confusing USA Computing Olympiad training problem. It turned out I was reading the question wrong and all it required was a simple greedy algorithm, which is very easy to program and use. Greedy algorithms are simply algorithms which do not take into account the possible future outcomes of the decisions they make. They are generally easy to program and debug, so it is good to use them whenever they can solve a problem.

The problem was as follows:

"Since milk packaging is such a low margin business, it is important to keep the price of the raw product (milk) as low as possible. Help Merry Milk Makers get the milk they need in the cheapest possible manner.

The Merry Milk Makers Company has several farmers from which they may buy milk, and each one has a (potentially) different price at which they sell to the milk packing plant. Moreover, as a cow can only produce so much milk a day, the farmers only have so much milk to sell per day. Each day, Merry Milk Makers can purchase an integral amount of milk from each farmer, less than or equal to the farmer's limit.

Given the Merry Milk Makers' daily requirement of milk, along with the cost per gallon and amount of available milk for each farmer, calculate the minimum amount of money that it takes to fulfill the Merry Milk Makers' requirements.

Note: The total milk produced per day by the farmers will be sufficient to meet the demands of the Merry Milk Makers." From USACO Training.

After re-reading the problem, I realized I just had to sort the information of all of the farmers according to their price per gallon and then use a greedy algorithm to calculate the lowest possible price for the amount of milk needed. I used the qsort function in "stdlib.h" to sort the list of farmers from the lowest price to the highest price. Then, the greedy algorithm calculated and kept track of the total cost and the amount of milk still needed, while getting milk from the farmer with the lowest price per gallon. The greedy algorithm then kept moving on to the next farmer on the sorted list if milk was still needed. Once the total amount of milk was reached, the program exited the greedy algorithm and printed the total cost to a file. That is an example of a very simple greedy algorithm.

To demonstrate thow it works. Here is a set sample output:

Unit Price:	Amount
5	20
9	40
3	10
8	80
6	30

Sorted by unit price:

Unit Price:	Amount
3	10
5	20
6	30
8	80
9	40

I have 0 gallons of milk.
100 gallons of milk are still needed.
Total cost so far is 0 cents.
Lowest price available is 3 cents per gallon.
Amount available at current lowest price is 10 gallons.

I have 10 gallons of milk.
90 gallons of milk are still needed.
Total cost so far is 30 cents.
Lowest price available is 5 cents per gallon.
Amount available at current lowest price is 20 gallons.

I have 30 gallons of milk.
70 gallons of milk are still needed.
Total cost so far is 130 cents.
Lowest price available is 6 cents per gallon.
Amount available at current lowest price is 30 gallons.

I have 60 gallons of milk.
40 gallons of milk are still needed.
Total cost so far is 310 cents.
Lowest price available is 8 cents per gallon.
Amount available at current lowest price is 80 gallons.

I have 100 gallons of milk.
0 gallons of milk are still needed.
Final cost is 630 cents.

This algorithm sorts the farmers by their unit price and then keeps going down the list until it receives all the milk it needs.

More in Greedy Algorithm

- by Elizabeth Mabrey

There are multiple optimization greedy algorithms. Two that will soon be introduced to our Algorithm/C roboclub meeting are N-Queens and Huffman Compression Coding . As always, while we develop the code for optimization, we must bear in mind one thing: simplicity, and clear design.

First of all, about this problem Matthew S. has mentioned earlier, it works pretty elegantly but also simple enough to implement.

In simplest form, greedy algorithm works in phases. At each phase, you need to take the following approaches:

- take the best you can get right now, regardless future consequence;
- choose a *local* optimum at each step and expect that you will end up at a *global* optimum
- Local means what the state looks at the current step, such as just a couple of elements at a time. Global means what the state looks at the end.

Unfortunately, Greedy Algorithms do not always yield optimal solutions.

For example: *Find out a certain amount of money, using the fewest possible bills and coins.*

Using Greedy Algorithm, the proper step will be to take the largest possible bill or coin that does not overshoot.

e.g.: To create US$7.29, you can choose:
1x $5 bill
2x $1 bill
1 x 25¢ coin and
3 x 1¢ coins
Thus, there are total of 7 items (3 bills and 4 coins).

However, let's assume some imaginary dominations of currency named "Kuku":
1 Kuku, 7 Kuku, and 10 Kuku bills.
Try to create 16 Kukus with Greedy Algorithm, you get:
1 x 10 Kuku bills
6 x 1 Kuku bills

Thus, there are total of 7 bills. However, as you probably have noticed that you can create 16 Kuku with just 4 bills instead of 7, i.e. 2 x 7 Kuku + 2 x 1 Kuku.

The main reason for the Greedy Algorithm failing to give the most optimal solution is the fact that you must make a binary (0 -1) choice for each bill/coin. If you can pick fractions of items, the Greedy Algorithm will likely give a much more promising solution.

Huffman Code— Greedy Algorithm

One of the typical Greedy Algorithm is Huffman Coding. This is one very typical data compression algorithm which yields lossless compression of files based on the frequency of occurrence of a symbol in the file which is being compressed. It is called a greedy algorithm because the choice being made bases on the highest number of occurrence of a character.

For example, for a file which contains 220 characters:

100	45	50	10	5	10
A	E	I	O	Z	R

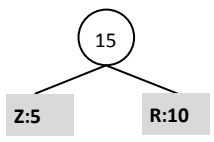
ie. there are 100 'A', 45 'E', etc.

Step 1: order by frequency:

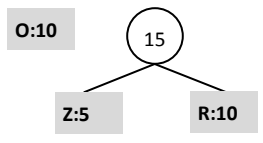
Z:5 O:10 R:10 E:45 I:50 A:100

Step 2: Create a binary tree by putting min on left, max on right; and sum the frequency as the parent node:

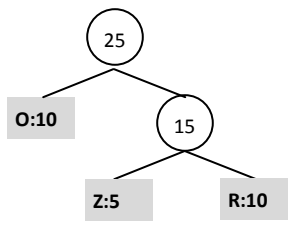
2.a pair:



2b. move

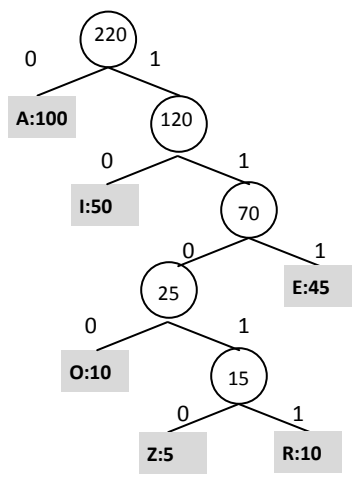


Repeat 2a & 2b. :



Repeating "pair" and "move until you are done.

Step 3: assign bit 0 on each left branch, and 1 on each right branch. Then, your binary tree will be the following:



Hoffman code scheme for this file:

	Bits w/compression
A = 0	1x100= 100
I = 10	2x50 = 100
E = 111	3x45 = 135
O = 1100	4x10 = 40
R = 11011	5x10 = 50
Z = 11010	5x5 = 25

Total 440 bits vs 1760bits (220x8bit) without compression. <u>There is almost 75% saving.</u>

Encoding sample:

"AZERO"= 0-11010-111-11011-1100

where "-" denotes concatenation.

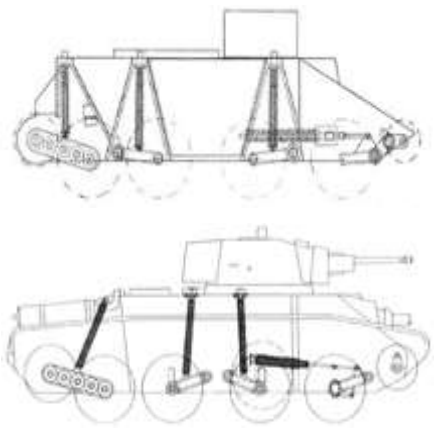
To Decode it:
Method 1: Create a character with its compressed code look up table.
OR
Method 2: Traverse the binary tree from the bottom leaf node.

(note: Knowledge required in order to program this: Recursive algorithm, double linked list for building binary tree, and binary representation.)

The Christie M1931

-By Andrew Chen

In World War One, most tanks were old-fashioned "Lozenge" tanks. These tanks were slow, unreliable, and tended to knock out their crew when coming down steep hills. Then, out of the midst of the war came a new, innovative tank. It was the Christie M1931. The M1931 was actually



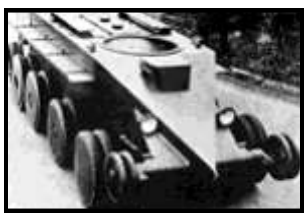
Suspension of M1931
http://derela.republika.pl/en/10tp.htm

far lighter than many tanks of the period, but it was still very popular. Why? This tank had the all-new "Christie" suspension system. The large bogie wheels of the Christie Suspension were individually attached to the hull, giving the crew a smooth ride. This also allowed the vehicle to have one wheel going up at a time, rather than the entire suspension bumping up all of a sudden.

The average "Lozenge" tank is like a box with treads and guns. If you put an orange into it and drop it off a hill, the orange is going to go SPLAT. But if you had box with treads, guns and a Christie Suspension, the orange will be just fine. This is equivalent to the orange being a human, going SPLAT is going unconscious, and the box with treads, guns, etc. would be the tank.

So exactly how does this connect to robotics? It's obvious- we incorporate the Christie Suspension into our robots. Plus, robots with low clearance can now go up steeper slopes, instead of getting stuck (i.e.. See the picture). This system would be essential for off-road racers, as it allows for high speeds and maneuverability. Coming around with that is the fact that the shock receivers attaching the wheels would let the tank go airborne and return to the ground with their crews still conscious, whereas a "Lozenge," with no suspension, would knock the crew unconscious on the drop.

As you've seen, the Christie



Christie T3 Medium Tank
www.wwiivehicles.com/usa/tanks-medium

Suspension is an incredibly flexible design and can help a whole lot with your robot. In fact, the Soviets used the Christie Suspension in their world-famous T-34 tank in 1942, which in turn led to the creation of some of the greatest tanks in the modern world.

So why don't you get to your Lego box and start building?

Soccket

-By Ashley Yang

Soccer is the most popular sport in the world. All you need is a bunch of kids, a ball, a field and a goal. Many of the kids in Africa and developing countries play soccer for fun.

The sOccket was developed by 4 girls from Harvard. They had heard that kids in developing countries used kerosene lamps to study at night because they don't have electricity. From their scientific studies, they found out that living with one lamp is equal to smoking 40 cigarettes a day. You can imagine how hazardous

www.slashgear.com

this is to health; especially to children.

sOccket continues...

Meanwhile, they knew that soccer was a sport that kids played all the time. The sOccket was born.

The name "sOccket" is a combination of the words soccer and socket.

The soccer ball, sOccket, looks like a normal ball on the outside, but it is extraordinary inside. The newer version has a gyro mechanism, so it makes energy whenever it moves. In 15 minute of play its makes enough energy to power a LED light for 3 hours or charge a battery or cellphone. And it's just 5 ounce heavier than a normal soccer ball.

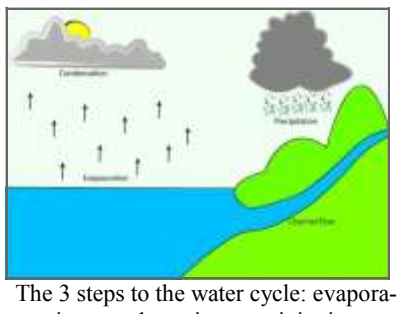
This ball is being sent to developing countries all over the world. So that the world's most popular sport is doing more than entertaining kids, it's also helping them light up their world.

http://news.discovery.com

Two Cycles of Life

-By Umar Ahmed Badami

I wrote about two kinds of



The 3 steps to the water cycle: evaporation, condensation, precipitation.
http://new.freshwaterlife.org

cycles: the Water Cycle, and Food Chains. Let's start with the Water Cycle. People think that volcanic gases may have purified to make storm clouds, which may have started the Water Cycle on Earth. The Water Cycle is also called the 'Hydrological Cycle'. Pretend you are a water droplet. You are in the sea with other water droplets. Suddenly, you feel like you are rising up into the sky. This is called evaporation. During evaporation, water droplets rise into the air, and turn to gas. You turn into part of a cloud, and darken. This is called condensation. Finally, you fall to the ground as water, ice, snow, or hail once again. This is called precipitation.

Now, let's talk about food chains. They start with the sun, and end with carnivores. Food chains are everywhere. For example an ocean food chain would go like this: plankton, to zooplankton, to anchovies, to tuna, and so on. An example of a land food chain would start at the sun, go to grass, then to caterpillars, then to birds, then to rattlesnakes, and finally to eagles. They end at eagles because nothing can eat an eagle. That's all for today, folks.

Cool to be in Robotics Club

-By Sebastian Tirado

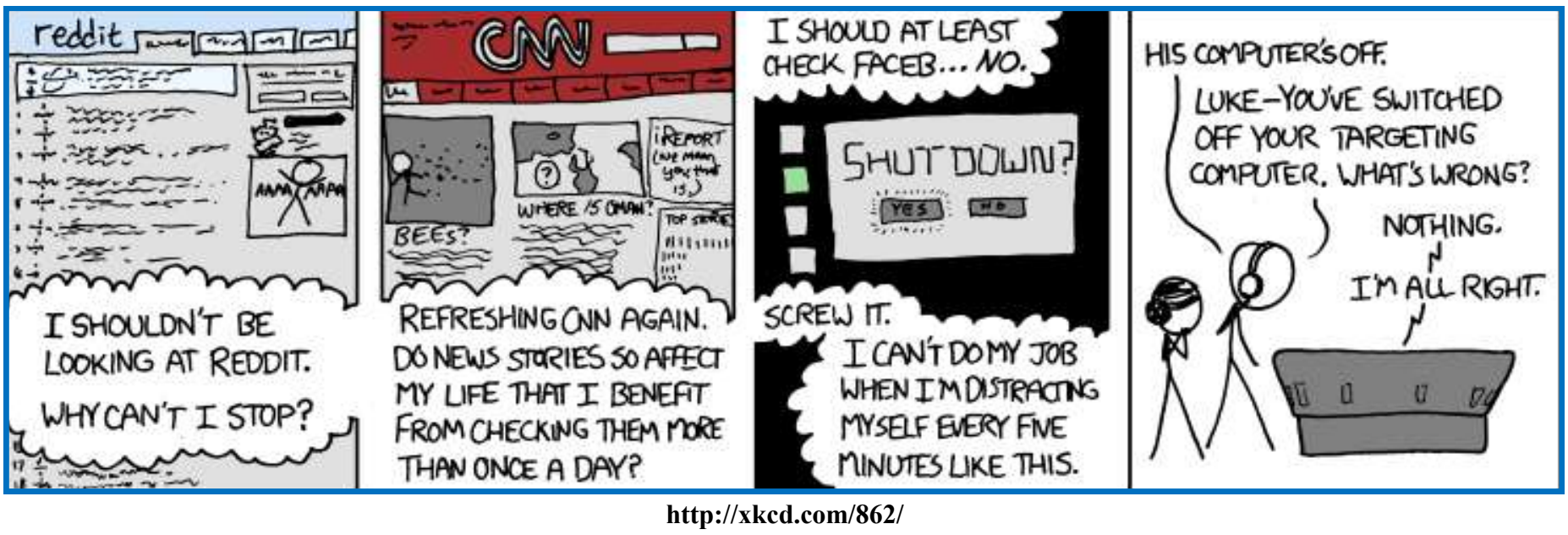
The Robotic club is a fun experience for all those interested in a tutorial about the amazing world of robotics. It develops our minds, unlocking our inner curiosity to explore more than meets the eye. At this club, we learn to program, and create machines that can later be used as tools in life, from medicine to exploring space. The idea of having automatic functions, besides the human body, is a dramatic twist in scientific development. There are robots to perform surgeries (such as the DaVinci), to clean up environmental disasters (Fish Robots), and to explore Mars (The Buggie). The most fascinating to me, are robots that build robotic prosthesis to help patients who have lost an extremity, or have a disability. These robots will help them move freely and be more independent.

When you learn to create something useful to people, it feels great! At Storming Robots robotics club, our teacher not only develops our creativity along with technical disciplines, but also teaches us the importance of team work, responsibility, and achievement, which are important skills that we need for the future. Like the famous quote said, "A mind is a terrible thing to waste." Never give up on curiosity, it may lead to a great discovery.

The Lighter Side.....

Have A Laugh with Robot Comics!

LOL



http://xkcd.com/862/

Light Bulbs Jokes...

(http://wilk4.com/humor/humorm321.htm)

Q: How many Heisenbergs does it take to screw in a light bulb?
A: If you know the number, you don't know where the socket is.

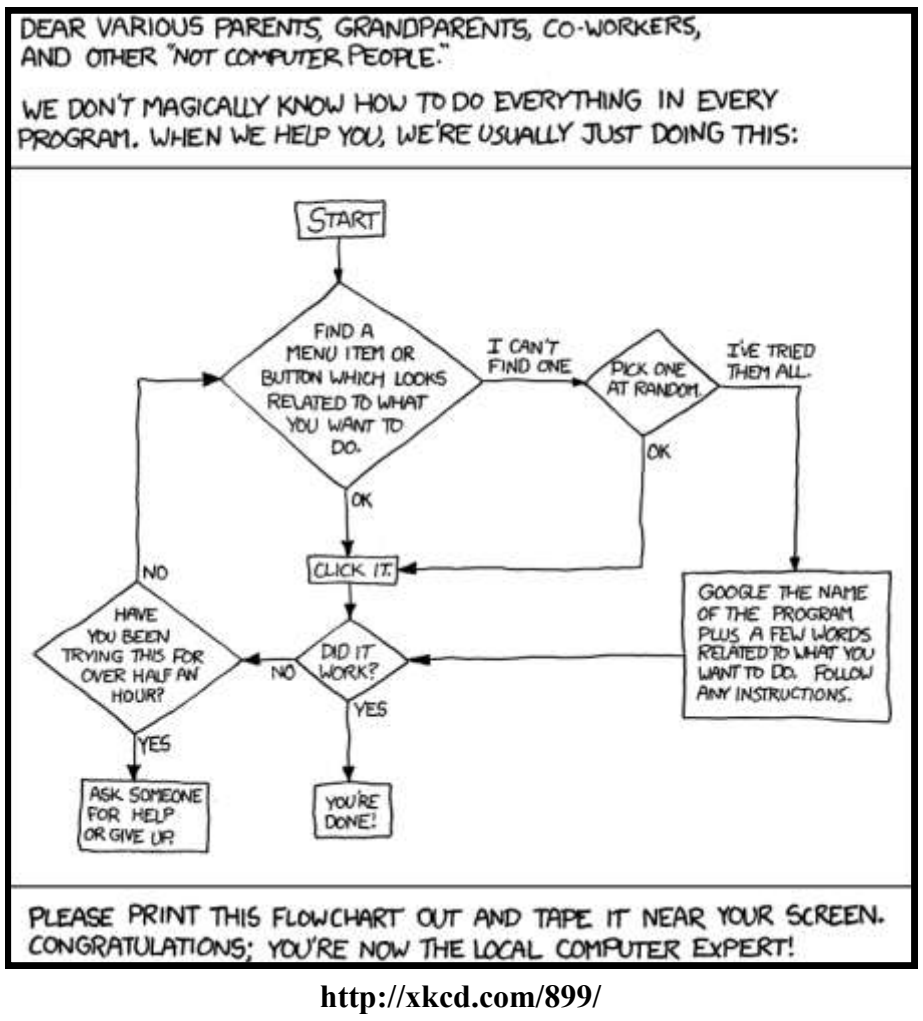
Q: How many quanta does it take to screw in a lightbulb?
A: One and a half.

Q: How many consulting engineers does it take to change a light bulb?
A: One, that'll be $50 please.

Q: How many nuclear physicists does it take to change a light bulb?
A: One, he raises it into place and the world revolves around him.

Q: How many Pentium owners does it take to change a light bulb?
A: 0.99987, but that's close enough for most applications.

Q: How many IBM employees does it take to change a light bulb?
A: Fifteen. Five to do it, and ten to write document number GC7500439-001, Multitasking Incadescent Source System Facility, of which 10% of the pages state only "This page intentionally left blank".



http://xkcd.com/899/

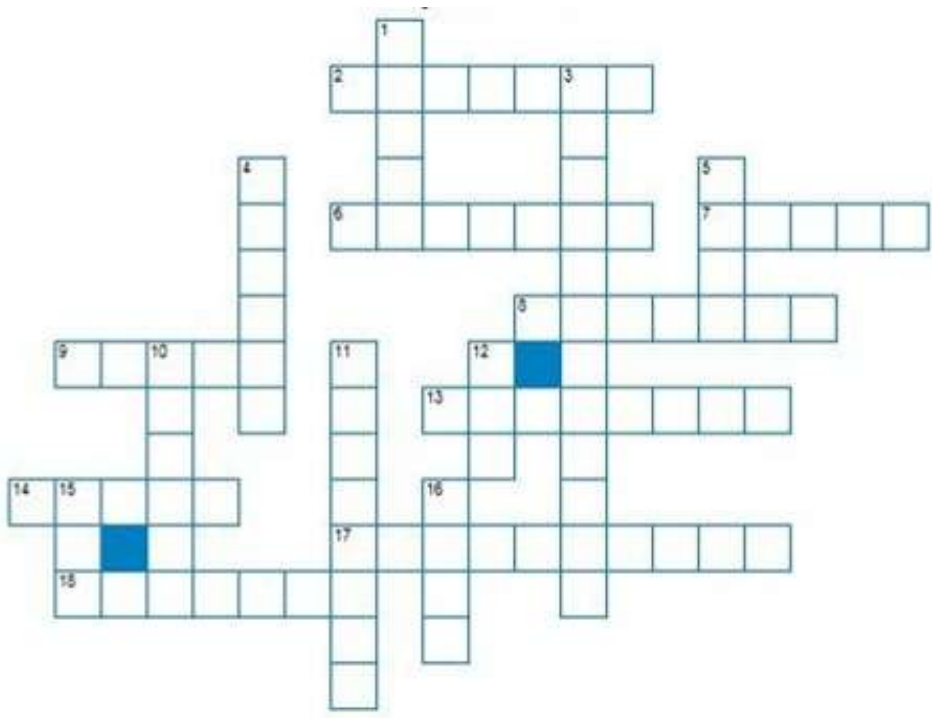
Student Comics

My Christmas Comic

- by Lucca Cioffi

Grade 5

CROSSWORD— PHYSICS AND ROBOTICS TRIVIA



Across

2) When you put your hand over a hot stove, you can feel the heat. You are feeling _____ energy in transfer.

6) One type of particples which make up the collective name nucleon is _____; which has no electrical charge.

7) 1000 in binary (base-2) = _____ in decimal (base-10).

8) _____ physics is the study of classical physics in the minimum amount of any physical entity involved in an interaction.

9) A _____ is an elementary particle and a fundamental constituent of matter.

Across *(continue...)*

13) Thermal energy is the _____ energy of the movement of atoms and molecules.

14) At 0 Kelvin scale, _____ are completely at rest.

17) One big difference between Neutrons and protons or electrons is that neutrons has no _____ charge.

18) The _____ fusion in the sun increases the sun's thermal energy.

Down

1) Atoms are made up of _____ types of particles.

3) _____ is -459.67 Fahrenheit.

4) Both Neutron and proton makes up of three _____.

5) Once the thermal energy leaves the sun in the form of radiation, it is called _____.

10) The total mass of protons, neutrons and electrons in a single atom is called _____ mass.

11) Inertia is a _____of massive objects, while momentum is a measurement of motion of massive objects.

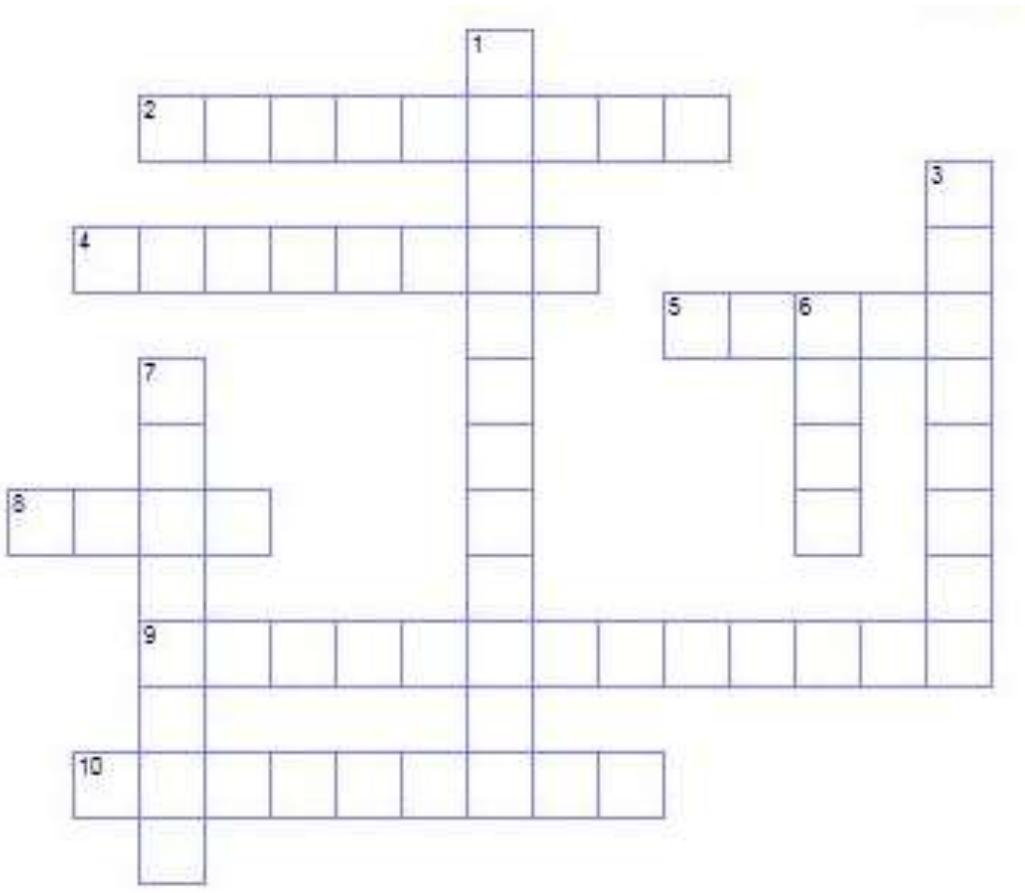
12) There are _____ types of quarks known as flavors.

15) 10000 in binary = _____ in hexadecimal (base-16)

16) 1011 1110 1110 1111in binary (base-2) = _____ in hexadecimal (base-16)

Answer Keys for the Crossword puzzle: Atoms Ten EIGHT BEEF quarks kinetics three Nuclear Heat thermal six Absolute zero Atomic neutron Property Quantum electrical quark

BASIC ROBOTICS TERMS



Across

2. "Dead _____" is a process of estimating a robot's current position based upon a previously determined position.
4. Robots may use _____ sensors to calculate the distance travelled.
5. 1000 in binary (base-2) = _____ in decimal (base-10).
8. 1111 1111 1111 1111in binary (base-2) = _____ in hexidecimal (base-16)
9. _____ is a device that used in Wii Controller to allow motion sensing control.
10. Usually, you calculate the distance traveled for the robot based on the size of its tire, encoder reading, and _____.

Down

1. Robots with two independent motors most likely do not run straight, becasue of the _____ output.
3. An _____ is a mechanism that puts something into automatic actions.
6. _____ sensors meaures the angular rate change.
7. You use _____ sensor to view UV light.

Answer Keys for the Crossword puzzle: accelerometer inconsistent eight gearratio fff rotation actuator gyro reckoning infrared

Schedule!

Home Site:	http://www.stormingrobots.com
	If classes need to be cancelled due to inclement weather, notification will be posted right on the home site.
Center Calendar	http://cal.stormingrobots.com
Summer programs:	http://summer.stormingrobots.com
Twitter:	http://www.twitter.com/stormingrobots
Jan 23rd:	MIT/NASA ZeroRobotics ISS Final Webcast . Since almost everyone in our team has semi-final exams during that week, we will not attend the event even our alliance team was named as one of the finalists. However, it will be broadcast live on NASA TV (http://www.nasa.gov/ntv), or the http://zerorobotics.mit.edu/ home page, starting at 08:00 EST .
Jan 25th:	Start to accept articles for 2012 Spring Newspaper issue.
Feb 1st:	Summer RoboCamp/Workshops Open Registration.
March 1st:	Renewal for Spring Term starts.
March 18th:	Last Day of Winter term of Roboclub
March 21st:	First day of Spring term of Roboclub
April 2nd—5th:	Spring Break Workshop (Gr. 4 – 8)
April 2nd—8th	**No roboclub meetings.**
April 8th:	Free intro workshop to "Self-awareness from robot!" During the National Robotics Week . **No**-walk in. Pre-registration is required online at http://workshops.stormingrobots.com
April 22nd:	RobocupJunior Tournament. Location is yet announced. Visit http://teams.stormingrobots.com or http://rcj.robocup.org to obtain details.
June 10th:	Last Day of Spring Term of Roboclub
June 18th:	Articles due for the 2012 Spring Newspaper issue.

Spring Break Highlight:

http://workshops.stormingrobots.com

	Grades	Workshops	Location
Apr 2-5	4 to 8	Robotics Tech Projects	SR

Summer Highlight:

http://workshops.stormingrobots.com

	Grades	Tentative Workshops	Location
Jun 25-29	4 to 8	Robotics Tech Projects	SR
	4 to 8	Engineering For Girls	SR
Jul 2-6	—	closed	—
Jul 9-13	4 to 8	Robo500 Grand Challenge	SR
	7+	Programming in C /Math - AM	SR
	7+	Programming in C with Robot - PM	SR
	2 to 3	Mechanical Dog	DOC
		Merry-Go-Round	DOC
Jul 16-20	4 to 6	Robotics Scavenger Hunt	DOC
	7+	IRC — Bluetooth *(Inter-Robots-Communication)*	SR
Jul 23-27	4 to 6	Remote Control Racing Bot	SR
	7+	IRC — Robotics Soccer	SR
Jul 30–	5 to 8	Robotics Fun with Math	SR
Aug 3	7+	IRC — Motion Sensing	SR
	8-11	Physics with Robotics	RPS
Aug 6-10	4 to 6	Robots Sabotage	SR
	7+	Programming in C /Math - AM	SR
	7+	Programming in C with Robot - PM	SR
Aug 13-17	7+	Arduino Projects (Bring home the bot)	SR
	4 to 6	Robotics Projects (Bring home the bot)	SR
	2 to 3	Pneumatic	DOC
	2 to 3	Merry Go Round II	DOC
Aug 20-24	4 to 8	Robo500 Grand Challenge	SR
	4 to 8	IRC - Treasure Hunting	SR
Aug 27-31		TBD	SR

Latest schedule: http://summer.stormingrobots.com

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