SCRATCH

Department of Computer Science

K-12 Computational Thinking Program

http://www.cs.iastate.edu

Computational thinking is a critical thinking skill that, according to some, is a required skill for success in the 21st century! Many students are only trained to become users of a computer, rather than developers. We think everyone should know how to make the computer work for you!

The key goal of the K-12 Computational Thinking Program is to encourage educators and students to adopt the practice of computational thinking through the development of computational models. Students develop a mindset that computational thinking and computational modeling are tools for solving problems and developing models of STEM concepts. Increasing the computer literacy of the K-12 students in Iowa requires them to move beyond just being a computer user. To encourage them to engage in computer program deveopment, students and teachers will be introduced to the Scratch™ programming language (freely available from Scratch™ .mit.edu) as an easy to use, yet powerful way of applying computational modeling.

By developing programming skills, more students will likely find interest in computing careers.

Computational Thinking Competition April 16, 2016

Above: Winners from the 2015 CTC

The ISU Computational Thinking Competition seeks to introduce K-12 students to problem solving with computational thinking in the context of their current coursework in Iowa schools. Student projects are in the form of computational models that help students to understand a problem, understand all of the requirements for a solution, be able to test their solution, and demonstrate the solution.

Computational Thinking for K-12 Teachers

Modeling has become a requirement in the new Iowa Curriculum. Do you know how you are going to implement this in your classroom? Scratch is the answer! In addition to the workshops and competition for students, the ISU Computer Science Department also offers summer K-12 Teacher Certification Classes, family/student programming nights (in your school or library), and K-12 Teacher Inservice training sessions. Contact us if you have questions, or are interested in learning more about introducing computational thinking to your students.

Fall 2015 - Spring 2016

Workshop Dates:
Oct. 17, Nov. 7, Jan. 16, Feb. 6 and Mar. 5

Students, teachers and parents interested in learning more about computational thinking, or preparing for the CTC can attend one of our CTC workshops, held on the ISU campus, in Pearson Hall on Saturday morning from 9:00a.m. -12:30p.m. covering computational thinking process, program design and scratch.

www.cs.iastate.edu

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IOWA STATE UNIVERSITY

Department of Computer Science

K-12 Computational Thinking Competition - April 16th, 2016

Computational Thinking

Definition of Computational Thinking: Computational thinking means thinking like a computer scientist. To do that in this competition, you will need to solve the problem posed by your project in the context of a computational model.

Computational Model

Definition of a Computational Model (note that the use of a computer is not required.)

- There must be an instruction set.
- The Computational Model must be able to store data and have the ability to support abstraction.
- The instruction set must be able to operate on the data.
- The Computational Model must support input (a way to get data into the model) and output (results of the solution need to be visible to the judges).

Project Choice

The project choice depends on the interests of the students involved. The project could come from any school subject, but projects are probably easier to find in science or mathematics classes. The thing to look for in choosing a project for this competition is, does the project pose a problem (task) that needs to be solved?

Competition Rules and Judging Rubric

Each entry (individual or team) must have a project that requires a solution and the solution must be solved using computational thinking. Each student will present their project to a team of judges.

Judges will rate the entries on:

- difficulty of the problem posed by the project
- cleverness of the solution to the problem
- appropriateness and cleverness of the computational model
- ability of the student(s) to explain how the project works

The competition will be divided by age divisions. These will be announced in fall 2015. Each division will be awarded 1st, 2nd and 3rd prizes. Prizes include laptops, netbooks, tablets, and other tech gadgets.

Find out more at https://www.cs.iastate.edu/outreach

www.scratch.mit.edu

Sign up for a Computational Thinking Workshop -
Saturdays : October 17th, 2015, November 7th, 2015,
January 16th 2016, February 6th, 2016,
March 5th, 2016

Computational Modeling using Scratch™

1. Make sure that you **understand the underlying principles** of the concept that you want to model and you understand how to use Scratch™!

2. Sketch the main scenes of the concept (storyboard).

3. Identify the components that play a role in your sketches.

4. Create an image for each of the components and create a ***sprite*** in Scratch™ for each component using the image.

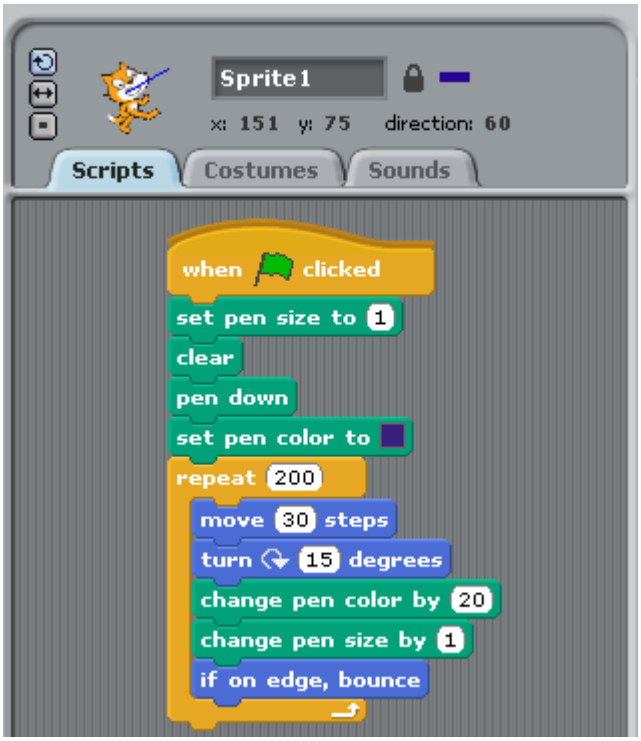
5. Write a brief description of what each component (that you identified in 3) does.

6. Use the descriptions to create the Scratch™ ***scripts*** for each ***sprite*** (component). An important part of the ***scripts*** is how the ***sprites*** communicate (***broadcast/receive*** messages).

7. Once you have the ***scripts***, you have most of the modeling job complete. Now you just have to decide what starts out on the screen and what is hidden. You are ready to run the Scratch™ model. It may run too fast and you may need to put in a few ***wait*** commands to slow it down.

A Scratch program to try:

Another Scratch program you can try:



The Computational Modeling Approach using Scratch™ provides a pedagogical approach for learning how to model dynamic science and mathematics concepts. Modeling with Scratch™ requires that you use critical thinking, inquiry, logical thinking and problem solving.

1. [Critical Thinking and Inquiry] *Make sure that you understand the underlying principles of the concept that you want to model!*

Make sure that you have created an environment where your students have access to a variety of information on the concept they are trying to model. They have to understand the concepts that they are trying to model at a deep level before they can start. Note that the approach to this understanding is going to require a deeper understanding than they might be used to. A key issue is that they will have to understand the behavior of the concepts in terms of some unit of time in order to create the model. To do that they have to seek out information on the concept that allows them to understand the action of the concept with in that time unit.

- What does time mean in the context of modeling? It depends on what we are modeling. If we are modeling the two train word problem, we have choices for the basic time unit – hours, minutes and seconds. Any of these would work, but minutes is likely the best choice as hours makes the model jerky and seconds takes too long. Modeling half-life of an isotope could use one half-life interval as the time unit with some suitable delay to match the half-life interval of the isotope being modeled. Seconds would be a reasonable choice of time unit for modeling bat wing speed.

- Modeling requires the student to be able to make reasonable assumptions. Even the most sophisticated models developed by mathematicians and scientists use assumptions to simplify the underlying aspects of the concept that is being modeled. In some cases the assumptions are used because there is no precise understanding of how the concept works. Even if you know all of the details, it might be too complex to create a useful model. Modeling weather is a good example of both of these. It is extremely complex and no one knows exactly how all of the aspects of our environment fit together. Making appropriate assumptions is critical to making the modeling process grade appropriate.

- Another key issue is to decide how to look at the concept you are modeling. In many cases this is the hardest part of modeling. Half-life of isotopes in science is an interesting example that brings all three of these concepts together. First, it is very hard to teach due to the fact that it is a probabilistic process that says that on the average half of the isotopes will decay (turn into a more stable element) each half-life. That gives us a reasonable choice for the basic time unit (half-life interval). By studying the information on half-life, we can see that there is a probability decay function (that is too hard for most people) that determines whether a particular isotope will decay at any point. If we think about this enough with enough good information at hand, we can realize that this means that each individual isotope has a probability associated with it. We can then make an assumption that we just put a simple probability, say choose a number in the range 1 to 10, and make the isotope decay if the number is greater than 5. The key is that we are using what we know about the concept to look at it a little differently than we have in the past.

2. [Critcal Thinking] *Sketch the main scene**s** of the concept (story board).*

- This step requires that the students understand the concepts of the model well enough to allow them to sketch out a series of scenes over the unit time. It is important that the sketches have enough detail that students can use the scenes to explain their model to other students and their

teacher. The students will already have made assumptions to simplify the model, but it is important that they have sufficient detail. If they are adding a lot of detail when they are explaining the scenes, the resulting model likely will not be what the student is expecting. The more the students explain their storyboard, the easier it will be to move forward.

3. [Critical Thinking] *Identify the components that play a role in your sketches.* They should be the main objects in the storyboard scenes.

- The issue here is to pick the individual objects that will be manipulated. For different ways of looking at the same object, it is better to use Scratch™ costumes.

4. [Inquiry] *Create an image for each of the components and create a **sprite** in Scratch™ for each component using the image.*

- The image needs to realistic enough to allow other students to easily understand what is being modeled.

5. [Critical Thinking, Inquiry, and Problem Solving] *Write a brief description of what each component (that you identified in 4) does.*

- It is important that this includes the notion of the time unit that your student has chosen.

- These descriptions are very important. They will dictate the way the student will write the Scratch™ scripts (program segments). The length of the descriptions should be related to the complexity needed to explain how the component is manipulated over time. If these descriptions are missing important details, it is hard to design the appropriate scripts. A good practice is to have the students discuss their component descriptions in the context of the storyboard scenes they constructed in 2.

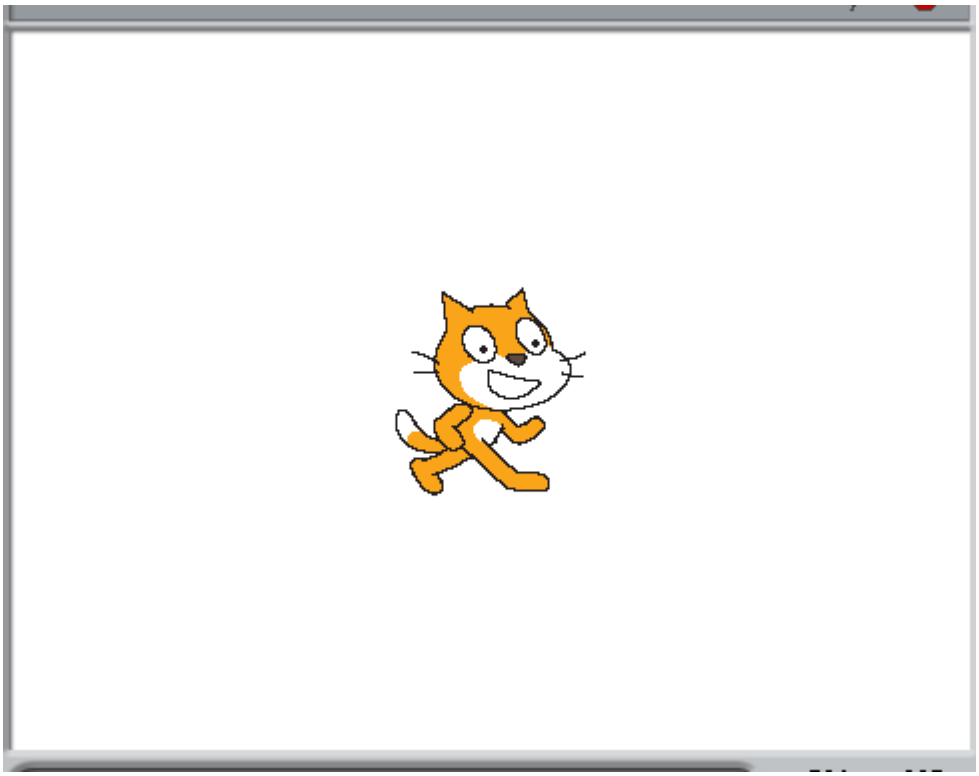
6. [Critical Thinking, Problem Solving, and Logical Thinking] *Use the descriptions to create the Scratch™ **scripts** for each **sprite** (component). An important part of the **scripts** is how the **sprites** communicate (**broadcast**/**receive** messages).*

- The unit of time chosen as the basis of the model will mean that each pass through the main loop will require that amount of time. For example if you are modeling bat wings and you have found that a bat's wings beat 17 times a second, your loop should require approximately 1/17= 0.0588 seconds

7. [Critical Thinking, Problem Solving, and Logical Thinking] *Once you have the **scripts**, you have most of the modeling job complete. Now you just have to decide what starts out on the screen and what is hidden. You are ready to run the Scratch™ model. It may run too fast and you may need to put in a few **wait** commands to slow it down.*

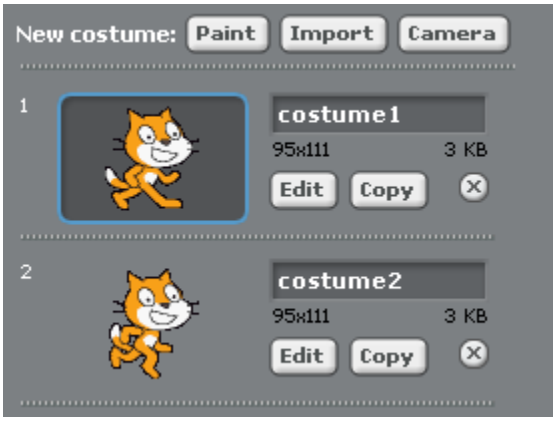
- Note that your understanding of the concept that you are modeling in the context of time will tell you where to put the wait commands and how much time to wait.

Running Cat



A simple program that shows how you can use change costumes to create a simple script that provides motion with very little programming. Note that the sprite has to have at least two costumes. Click on Costumes tab 

at the top of the screen and you should see



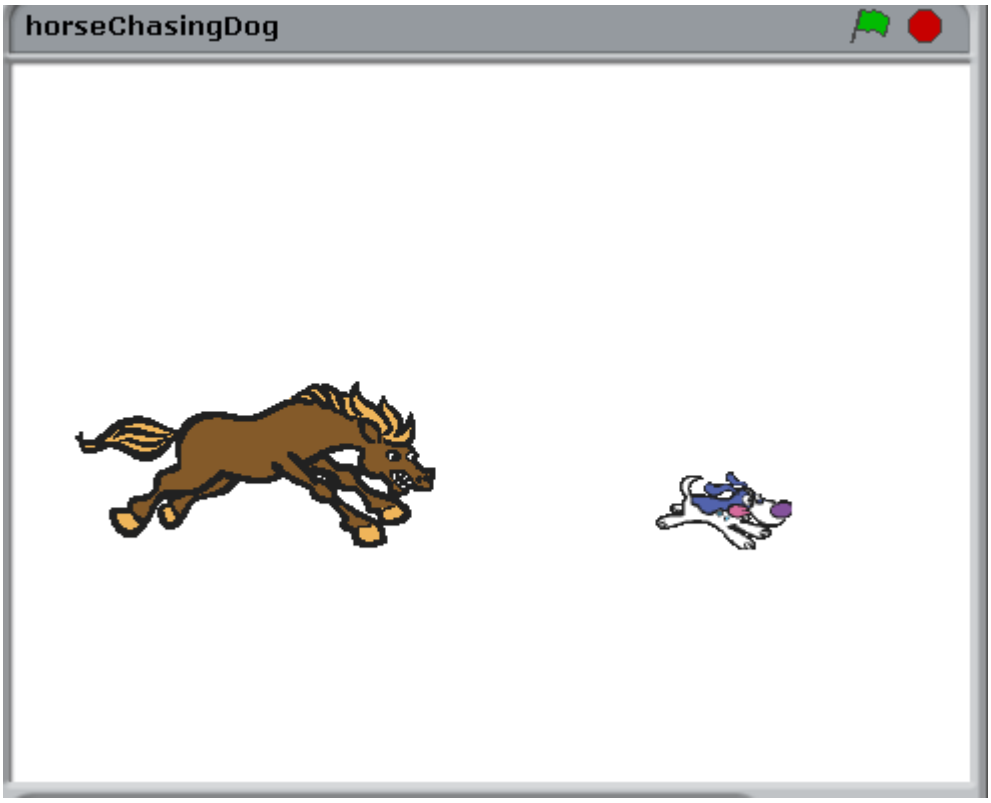
showing that the cat has two costumes (note that when you import or draw your own sprite you will have to make sure that you have imported or drawn a second costume to make this work.

Your script (make sure you have clicked on the 

tab) to make the cat appear to run might look something like

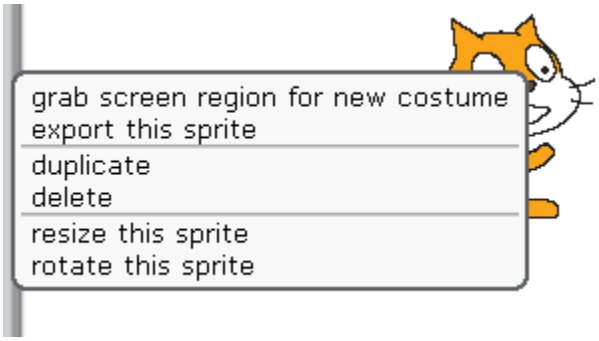
Note that the wait 0.05 is used to slow the cat down a little. The choice of 77 is not important, but the bigger the number is the longer it will run.

Horse Chasing Dog



This simple program is an example of using two sprites and communicating between their scripts using the broadcast command. Note in the programs (scripts) on back that at end of the Horse script, that it broadcasts the message bark (just a word that was chosen as the name of the message).

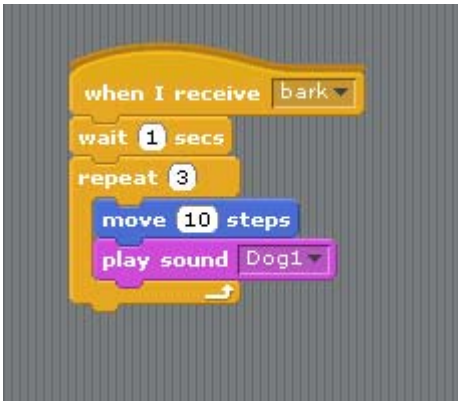
To set up the Horse Chasing a Dog program you will first need to delete the cat. You can remove a sprite by right clicking on it. You will see

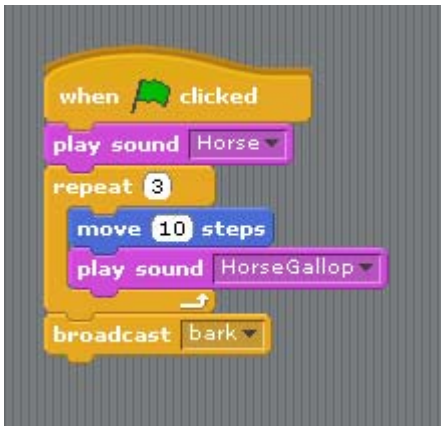


If you left click on delete the cat sprite will be gone and you will be ready to import the horse and dog.

Left click on  you will see a folder of Costumes. Click on the Animal folder and scroll down the

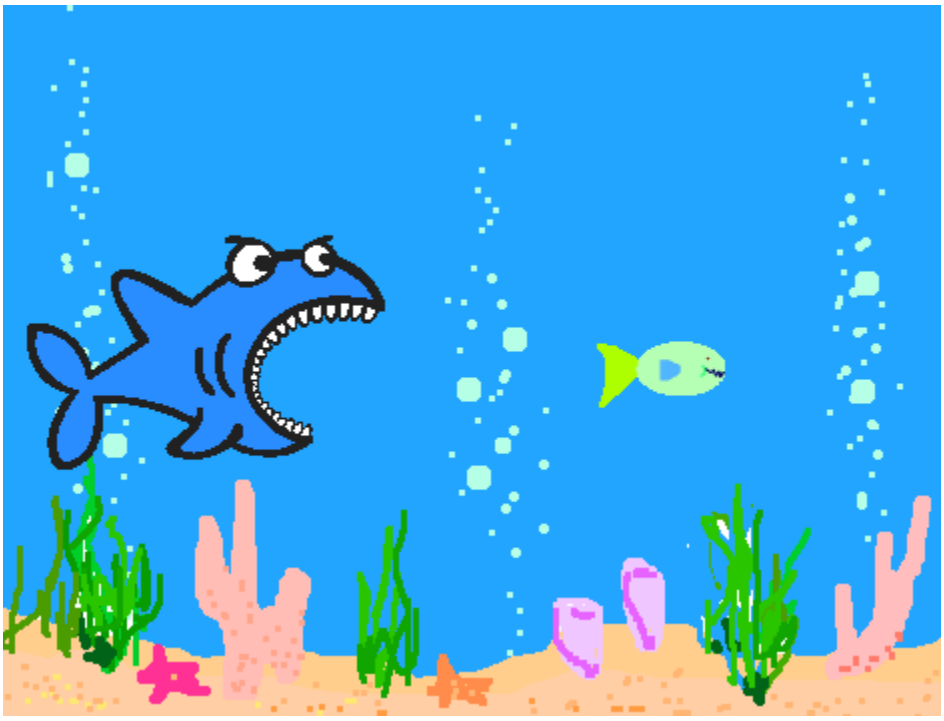
images of animals until you find the dog. Click on the dog that you want and click okay. The dog is now Sprite1. It may be a little big so you may need to resize it. Do the same for the horse and you are ready to create the programs (scripts) shown below. The current sprite is the one outlined in blue. Enter the script for the one outlined in blue and then click on the other sprite so that it outlined in blue and enter that script. You are now ready to run the program.





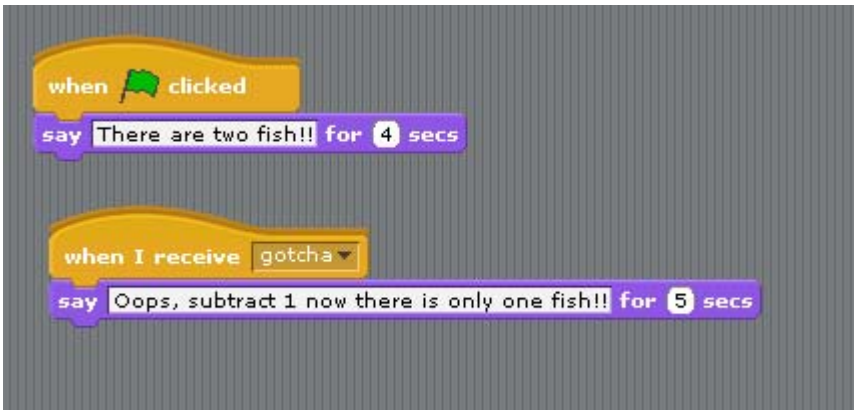
A Fish Story that Shows Subtraction

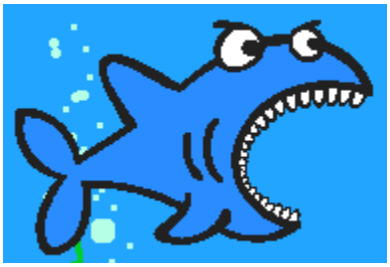
A big fish subtracts one fish by chomping a smaller fish.



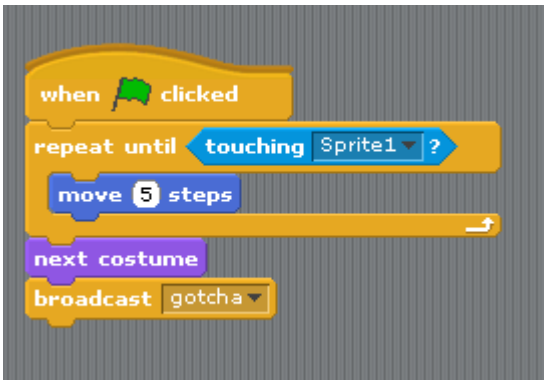
The Scratch program uses three sprites to tell the story:

-- A sprite (Sprite3) used to tell the story and yet be invisible. Program (scripts) for the sprite below.

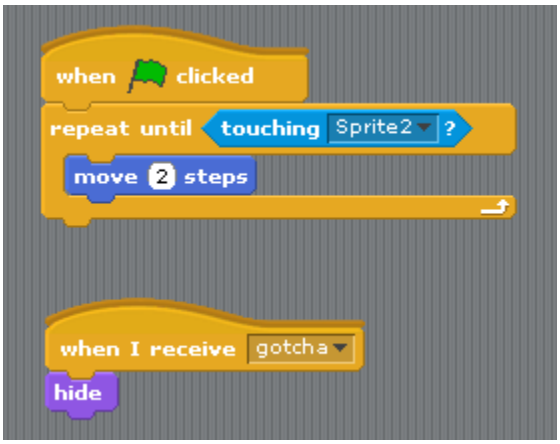




The big fish (Sprite2) is out to get the little fish for lunch. Program (scripts) below.



The little fish (Sprite1) gets chomped and hides. Program (script) below.



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Advising Students About Computing Careers

Many resources can be found online for helping students understand the rich career opportunities in computing fields. Here, we recommend to you just a few of our favorites.

The Computer Science Teachers Association is a membership organization that supports and promotes the teaching of computer science and other computing disciplines. CSTA provides opportunities for K-12 teachers and students to better understand the computing disciplines and to more successfully prepare themselves to teach and learn. Membership for individuals is free.
Visit them at http://www.csta.acm.org/

The Association for Computing Machinery is the world's largest educational and scientific computing society, and delivers resources that advance computing as a science and a profession. A leader in promoting Computer Science Education Week each year (see http://www.csedweek.org), the ACM is a critical resource for the entire IT industry and computing educators and researchers. The ACM Computing Careers website (http://computingcareers.acm.org/) offers students many ideas about computing careers. Visit the ACM at http://www/acm.org

The National Center for Women & Information Technology is a coalition that believes that inspiring more women to choose careers in IT isn't about parity; it's a compelling issue of innovation, competitiveness, and workforce sustainability. In a global economy, gender diversity in IT means a larger and more competitive workforce; in a world dependent on innovation, it means the ability to design technology that is as broad and creative as the people it serves. Check out their resources at http://www.ncwit.org/

The Sloan Career Cornerstone Center is an ever-expanding resource for anyone interested in exploring career opportunities in science, technology, engineering, mathematics, computing, and healthcare. Explore over 185 degree fields & find out about education requirements, salaries, networking, precollege ideas, and career planning resources. Interviews with hundreds of professionals offer candid insight into their own diverse careers. Most resources are also as PDFs, PowerPoints, and podcasts. http://www.careercornerstone.org/index/htm

IOWA STATE UNIVERSITY
Department of Computer Science

The Department of Computer Science at ISU is a great resource for you! Bring your students on a campus visit so they can see for themselves what college life is like. High school students can visit with current undergraduate students in Computer Science and Software Engineering, and hear about the opportunities our students have discovered with their degree choice. Faculty will talk with your students about the many career options available to people with developer skills. Visit a research lab and find out how research is performed in computing. Schedule a visit today!
http://www.cs.iastate.edu

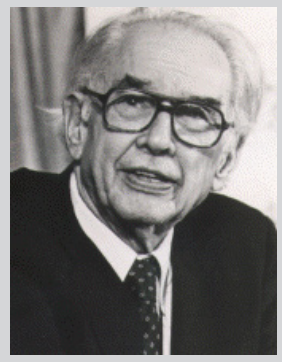
Today's High Tech Growth is Tomorrow's High-Tech Boom

The need for computing professionals and executives right here in the U.S. is growing as companies become more global.

The Life of John Atanasoff

Here at Atanasoff Hall, home to the Department of Computer Science, we are honored to have a building named after a prominent and important inventor.

John Atanasoff, the man who invented the computer, revolutionized society with his contributions to technology and theory. Atanasoff began his graduate studies at Iowa State College in 1925. After receiving his master's degree in mathematics, he continued on at the University of Wisconsin-Madison under John Hasbrouck Van Vleck, a Nobel laureate.



John Atanasoff
1903 - 1995

The work on his doctoral thesis, *The Dielectric Constant of Helium*, gave him his first experience in serious computing. During the hard weeks of calculations to complete his thesis, Atanasoff acquired an interest in developing a better and faster computing machine. After receiving his Ph.D. in theoretical physics, he returned to Iowa in July 1930 with a determination to make this machine a reality.

In the fall of 1930 he became a member of the Iowa State College faculty as professor in mathematics and physics. It was shortly thereafter that he, along with graduate student Clifford Berry, started to work on the world's first electronic digital computer. The computer would later be named the Atanasoff- Berry Computer (ABC). The original vacuum tubes from this computer can still be found at Iowa State University in the building next to Atanasoff Hall.

All about Computing Degrees

Computer Engineering

(CprE) students study the design of digital hardware and software including communications systems, computers and devices such as phones, MP3 players, DVR's alarm systems, x-ray machines, and even laser surgical tools.

Computer Science

(CS) spans the range from theory to practice to cutting edge inventions. CS trains graduates regarding new technologies and ideas on how to solve problems. They design and build software and create efficient solutions to real-world problems in fields such as robotics, computer-enhanced vision, and digital forensics.

Software Engineers

(SE) see the whole picture: the life cycle of a product including efficiency and reliability, meeting customers' budgets, proper testing, and maintenance. Large, expensive software systems often play a vital role in safety- critical applications and are made up of many smaller building blocks.

Information Systems

(IS) specialists design computing solutions that provide companies, non-profit organizations and governments with the information they need to achieve their goals. IS employs computer systems to implement and improve the way organizations work.

Information Technology

(IT) makes a living by solving, supporting, troubleshooting and designing-- from web sites to networks, in organizations ranging from business and government to schools, health care, and more.

City of Ames

Rated # 1 best college town in 2014!
-liveability.com

Centrally and conveniently located in the heart of the Midwest and Iowa, Ames is known for its healthy, stable economy, flourishing cultural environment, and the world-renowned Iowa State University. Designated as 9th Best Place to Live in the United States by CNNMoney .com (2010), Ames is an attractive place for new businesses to locate and for existing businesses to expand. Iowa is a place where neighborhoods are friendly and commutes are short. A place where quality public education isn't just a dream, but a reality.

All Science is Computer Science!

What is Computer Science?

Computer Science is the study of processes that underlie the acquisition, organization, and communication of information. This information could be stored in digital computers, brains, genomes, or in complex organizations. Computer scientists are trained to develop efficient solutions to complex information processing problems and software systems that find applications in virtually every area of human endeavor. Computer science graduates, in addition to being prepared for careers in computing, are equipped with a strong foundation for pursuing advanced study leading to research positions, teaching careers, or leadership roles in government and industry.

CS

Iowa State University

Department of Computer Science

All Science is Computer Science

Choose Your Adventure at Iowa State

DEGREES

Do you want to help build the next generation of mobile phones, tiny media players, and even high-tech clothing? Or create new and more advanced medical tools?

COMPUTER ENGINEERING (CE) students study the design of digital hardware and software including communications systems, computers and devices such as phones, MP3 players, DVRs, alarm systems, x-ray machines, and even laser surgical tools. Increasingly, CE specialists integrate customized hardware and embedded software, to improve existing technologies and invent new ones.

Do you love to solve puzzles? Invent new ways of using computers? Or exchange theories about new ideas?

COMPUTER SCIENCE (CS) spans the range from theory to practice to cutting-edge inventions. CS makes graduates aware of new technologies and new ideas and is a foundation for many different computing careers. Computer scientists do varied work. They design and build software and create efficient solutions to real-world problems in fields such as robotics, computer-enhanced vision, and digital forensics. Individual computer science programs allow students to specialize in one or more of these fields.

Do you enjoy finding better ways to get things done using computers? Are you interested in understanding how computers can make businesses work better?

INFORMATION SYSTEMS (IS) specialists design computing solutions that provide companies, non-profit organizations and governments with the information they need to achieve their goals. IS employs computer systems to implement and improve the way organizations work. IS professionals combine their knowledge of computing and organizations to bridge the gap between technical and business specialists. Most IS programs are found in business schools, and may go by such names as management information systems, computer information systems, or business information systems. All IS degrees combine business and computing topics, but the emphasis between technical and organizational subjects varies.

Are you the one everyone calls when they want their own web site? Are you the troubleshooter everyone turns to when their computer acts weird?

PROFESSIONALS IN INFORMATION TECHNOLOGY (IT) make a living solving, supporting, troubleshooting and designing – from web sites to networks, in organizations ranging from business and government to schools, health care, and more.

IT specialists possess the ideal combination of knowledge and practical, hands-on expertise to support both an organization's technology infrastructure and the people who use it. They're responsible for selecting hardware and software products appropriate for an organization. IT professionals create and manage web sites and networks to provide a secure, efficient, and productive environment for everyone.

Directors, composers, and architects – they all see the big picture. Do you? Creating software products involves a lot more than just writing code.

SOFTWARE ENGINEERS (SE) see the whole picture, too – the life cycle of a product, including efficiency and reliability, meeting customers' budgets, proper testing, and maintenance. Large, expensive software systems often play a vital role in safety-critical applications and are made up of many smaller building blocks. Software engineers combine experience in computer science, engineering, and math to design, define, and organize many aspects of a complex software product.

Software engineering courses are offered both within computer science study and as separate degrees. Both share some courses in common, and CS graduates who want to head up large development projects increasingly pursue software engineering in graduate school.

Medical Imaging

Doctors today can clean the arteries of a patient's heart, preventing a future heart attack. Modern medical imaging can reveal a detailed view of clogged problem areas – without any surgery. CAT scans, MRIs, and ultrasounds are all the products of computing professionals.

- Computer engineers design the hardware.
- Computer scientists devise the algorithms to process images from electrical impulses.
- Software engineers write software and ensure that it meets medical quality standards.
- IT professionals connect the imaging equipment to the rest of the high-tech hospital gear.
- Information systems specialists ensure that the right medical staff gets the right information at the right time.

In just a few years, doctors will be able to operate on patients half a world away using remote cameras and robotic arms. Computing professionals will continue to push the boundaries of medicine.

Finding Information on the Web

Most people use search engines such as Google and Yahoo every day. But search engines for the web could be much better than they are today. How about searching for objects in pictures? Or sounds? Scenes in movies? The web is constantly growing. Search engines need to learn what information means.

- Computer scientists devise the revolutionary approaches that makes search possible.
- Software engineers develop the products that dig up results.
- Specialists in information systems design solutions that allow search companies to sell relevant advertisements.
- Computer engineers design complex, high-performance networks to cope with immense quantities of data.

Search technology has a long way to go, and it will take many computing professionals to make that happen.

Online Music & Movie Distribution

One day you might tell your grandchildren stories about what television was like. The future of music, movies, and all media is on the Internet. From iTunes to YouTube, commercial entertainment is moving to the Web – fast. Most of the major studios plan to distribute films online. The entertainment industry is being shaken up and the whole revolution is powered by technology and computing professionals.

- Computer scientists design the huge databases that store music, TV shows, and movies.
- Specialists in software engineering, IT, and computer science work with artists to create attractive, engaging interfaces for consumers.
- Information systems professionals design the logic that keeps track of customers' interests and provides recommendations.
- Computer engineers built the iPod and other portable media devices on which we play our downloads.

Mobile Devices

Soon, the idea of using your cell phone only for voice will seem old-fashioned. You already text your friends, but mobile phones are rapidly becoming much more. They can access the Web, play games, and even tell you where you are right now. Soon you'll be able to press a key and instantly buy tickets to see your favorite band at a club you're just walking by. Or pay bus fare just by hopping onto the bus you want to take.

- Computer engineers develop smaller, less power-hungry chips.
- Computer scientists create compression algorithms to transmit information more efficiently.
- Information systems specialists design the connections between businesses and mobile customers.
- IT specialists make sure that the hardware and software used behind the scenes is up-to-date.

Gaming

The Microsoft Xbox 360. The Sony Playstation 3. The Nintendo Wii. They're all great gaming machines, but the technology behind them isn't a game at all – it's seriously powerful stuff. And games aren't just for kids anymore. Adults not only play today's video games, they create them, too. At the heart of these virtual reality platforms is cutting edge computing.

- Computer engineers produce faster, more powerful chips capable of displaying ever more lifelike characters in 3-dimensional worlds.
- CS and SE experts create the artificial intelligence that makes each game challenging, keeping players coming back for more.
- IT professionals support networks and infrastructure that enable game development.
- IS professionals create systems for keeping track of customer feedback, behavior, and demand.

Q Do you want to help build the next generation of mobile phones, tiny media players, and even high-tech clothing? Or create new and more advanced medical tools? That's **Computer Engineering.**

A Learn to design digital hardware and software including communications systems, computers, and devices such as phones, MP3 players, DVRs, alarm systems, x-ray machines, and even laser surgical tools.

Q Do you love to solve puzzles? Invent new ways of using computers? Or exchange theories about new ideas? That's **Computer Science.**

A Design and build software, or solve real-world problems using robotics, computer-enhanced vision, digital forensics, and other innovations.

Q Do you see the big picture? Can you imagine whole new virtual worlds and experiences? That's **Software Engineering.**

A Develop computer games or software systems for safety-critical applications. Software applications are made up of many smaller programs carefully stacked together.

Q Do you enjoy finding better ways to get things done using computers? Are you interested in understanding how computers can make businesses work better? That's **Information Systems.**

A Design the next eBay auction site or iTunes music store! Business and computing overlap in major ways and you might be the next successful entrepreneur.

Q Do you help other people fix their computers or design their web sites? Are you the troubleshooter everyone turns to when their computer acts weird? That's **Information Technology.**

A Support, troubleshoot and design technology. Businesses, government, schools, health care, and other organizations all need IT specialists.

csta Computer Science Teachers Association

http://csta.acm.org

IMAGINE YOUR FUTURE in COMPUTING

From **entertainment** and **communication** to **conquering disease** or **eliminating hunger**—computer technologies provide **solutions to make life better.**

A high-tech world calls for **inspired and talented people.** Jobs in technology are growing and offer **big salaries.** Technological advances are creating **new jobs every day!**

Explore your interests in computing. Your high school may have classes and clubs. Talk with your guidance counselor and your school's computing or technology teachers to learn more about the **opportunities** ahead.

For more information visit http://computingcareers.acm.org

help

Medicine

- **design** the imaging hardware.
- **write** algorithms (mathematical steps) that let computers process images from electrical impulses.
- **write** software and make sure it is foolproof.
- **develop** systems for delivering images so doctors can diagnose a patient's condition quickly.

In just a few years, doctors will be able to operate on patients half a world away using remote cameras and robotic arms. Computing professionals will continue to push the boundaries of medicine.

play

Gaming

- **produce** faster, more powerful chips that can display ever more lifelike characters in 3-dimensional worlds.
- **create** the artificial intelligence that makes each game challenging, keeping players coming back for more.
- **build** support networks that enable game development.
- **create** systems for keeping track of who is playing and how they are doing.

Imagine not only playing today's video games, but inventing them, too.

lead

Finding Info on the web

- **invent** the revolutionary approaches that make searching possible.
- **develop** the products that dig up results.
- **design** ways for search companies to sell targeted advertising.
- **create** high-performance networks to process huge quantities of data.

Search technology has a long way to go, and it will take many computing experts to make that happen.

connect

- **design** faster chips that use less power.
- **invent** ways to transmit information more quickly.
- **connect** people on the move with mobile devices.
- **develop** cutting-edge hardware and software.

Mobile Devices

Think about life before the mobile phone. What new device will we say we "can't live without" in the next few years?

create

Online Music and Movie Distribution

- **build** huge databases that store music, TV shows, and movies.
- **work** with artists to create attractive, engaging download sites.
- **design** the systems to help people find things they will like.
- **create** new portable media devices to play the music and download video.

The entertainment industry is being shaken up and the whole revolution is powered by technology and computing professionals.