Full STEAM Ahead

Science, Technology, Engineering, Art, and Math from nclab More Than Coding

Issue 4, March 2017

Nevada STEM Coalition – Our Vision For Nevada

Camille Stegman, *Executive Director, Nevada STEM Coalition*

As the 21 st century opened for Nevada, we found ourselves with a new and different economy. This new economy will be requiring Nevada's young students to develop skills necessary for new industries, such as renewable power, computer automation, drones, and yet to be discovered aptitudes. In addition to Nevada's student populations, there is a need for educator retraining, so that teachers can provide opportunities for students to develop these new skills. The Nevada STEM Coalition, working with informal education, STEAM groups, community partners, and the STEM Advisory Council, is advocating of the development of these STEM skills in Nevada's students and in the educators that mentor them.

Our vision is that ALL Nevada students have the necessary skills in STEM to be productive in their personal, work, and civic lives. Our mission is to promote leadership and collaboration among business, community, education, and government stakeholders to increase the numbers of capable Nevada high school graduates who pursue STEM related jobs, degrees, and careers.

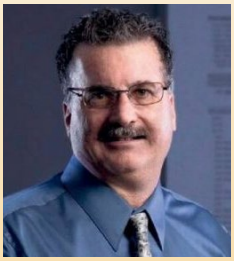
Founded in 2006, the Nevada STEM Coalition is a nonprofit organization who's founding member Beth Wells, was instrumental in bringing together stakeholders from across the state in the STEM Summit held in Las Vegas, Nevada in 2012. The participants represented Nevada education, community, business, and government, as well as out-of- state business and education institutions. Each group had their own perspectives about the importance of science, technology, engineering, and math (STEM) proficiency among Nevada's students and teachers. The outcomes of the summit provided a foundation for much of the work the Coalition has accomplished over the past several years.

One of these significant accomplishments is finding funding for the STEM Ambassador Program, which currently is in a pilot phase in Las Vegas. This program is designed to connect community partners with schools in varying levels of involvement and would not have been possible without the generous donation from NV Energy and Union Pacific. A STEM Ambassador is a STEM career individual that wants to share their knowledge and expertise with students. Through interactions with the STEM Ambassador, students may develop the desire to pursue a STEM-related career. Currently, the STEM Ambassador Program has over 70 ambassadors and that have interacted with over 300 students across Nevada. The STEM Ambassador Program has recently made connections to other communities in our state, including Reno, Elko, and their outlying communities.

As the Nevada STEM Coalition looks to the future it will continue to focus its mission and vision on our students and the educators who dedicate their careers to preparing them for Nevada's bright economic future.

The Nevada STEM Underwater and Aerial Vehicle Computer Science Institute (NSUAVCSI)

Brian Crosby, *STEM Training Facilitator, Northwest Nevada Regional Professional Development Program*



In my role as PreK – 12 STEM Learning Facilitator for northwest Nevada I applied for and received a Nevada College and Career Ready grant to support learning in computer science and Autonomous Unmanned Vehicles (UAVs). Both fields are vital for Nevada's future in general, but more so since Nevada was named as one of six states by federal officials to develop test sites for drones. It's the third state to gain FAA authorization to fly drones under a national program. The grant supported purchase of Parrot Rolling Spider and Phantom 3 Professional drones as well as OpenROV 2.8 underwater robot vehicles.

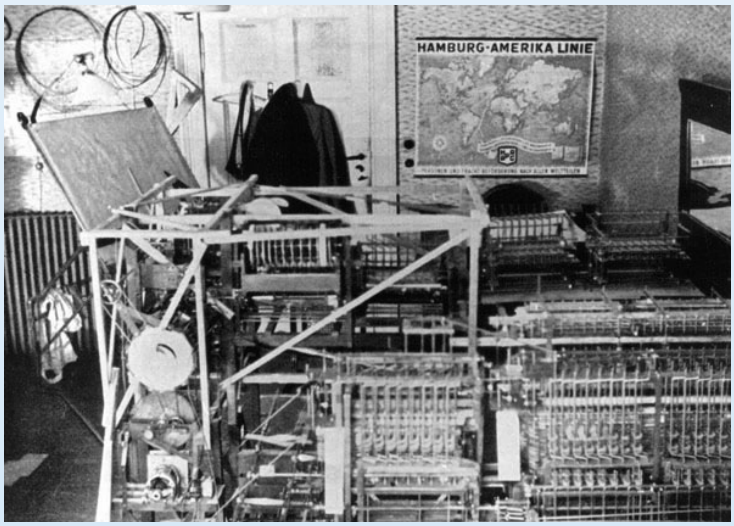
In addition, teacher and student access to the NCLab courses on Karel the Robot, Turtle Tina, Python Programming and 3D Modeling were provided for the 18 middle and high school teachers that successfully applied to NSUAVCSI and over 700 of their students. The design of the NSUAVCSI melds the high interest of UAVs with the urgent need for more Nevadans competent in computer science and computer programming. Teachers and their students are learning about the ethics, safety and use of UAVs from experts hired from local businesses and universities that specialize in them, and computer programming courses from NCLab that allow them to go as far as they desire in learning programming languages like Python and 3D Modeling. NCLab makes the courses available to students at school, home or anywhere they have an internet connection. The courses are self-paced, so motivated students can go as far and as fast as they want, when they want.

There have already been several news stories sharing the progress of the NSUAVCSI participants. The grant runs through the end of the current school year and teachers have access to over 75 AUV's to check out to use in their classrooms with students

Konrad Zuse And Z1 – the First Mechanical Computer

There is no doubt that the World War II pushed forward the development of the digital computer. In the USA it was the need to calculate firing tables for artillery and later the atomic bomb simulations (see Issue 1, December 2016). In the UK it was the highly secret code cracking work of Alan Turing and his team at Bletchley Park (see Issue 2, January 2017). An equally or more interesting development took place in Germany. But it may be different from what you expect.

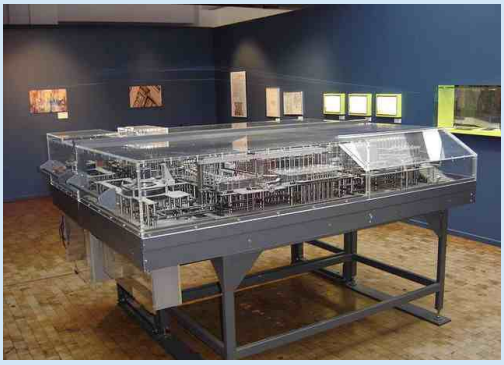
Konrad Zuse (1910 – 1995) graduated in 1935. He started working as mechanical stress analyst at the Henschel aircraft company. That meant solving large numbers of linear algebraic equations. In 1936 he started building a machine to ease these tedious calculations. Originally it was named V1 (Versuchsmodell = Testmodel). Zuse renamed it to Z1 (Zuse 1) later. The machine was finished in 1938 in his parent's living room and this is how it looked like



The Z1 was fully mechanical, there was no electricity involved. It consisted of over 30,000 metal parts. Today the Z1 is considered to be the first binary programmable computer.

The Z1 even had a keyboard and showed its results via a row of lights. Although its mechanical construction was ingenious, its most important feature was that it used binary numbers. All mechanical calculators before the Z1, and even Babagge's design, were based on decimal arithmetic. The machine wasn't reliable and of course it was very slow. It had nine instructions and each one took multiple cycles to complete and each cycle took one second.

In 1939, the German military commissioned Zuse to build the Z2, which was largely based on the Z1. Later, he completed the Z3 in May of 1941, the Z3 was a revolutionary computer for its time and is considered the first electro-mechanical and program-controlled computer. Finally, on July 12, 1950, Zuse completed and shipped the Z4 computer, which is considered to be the first commercial computer.

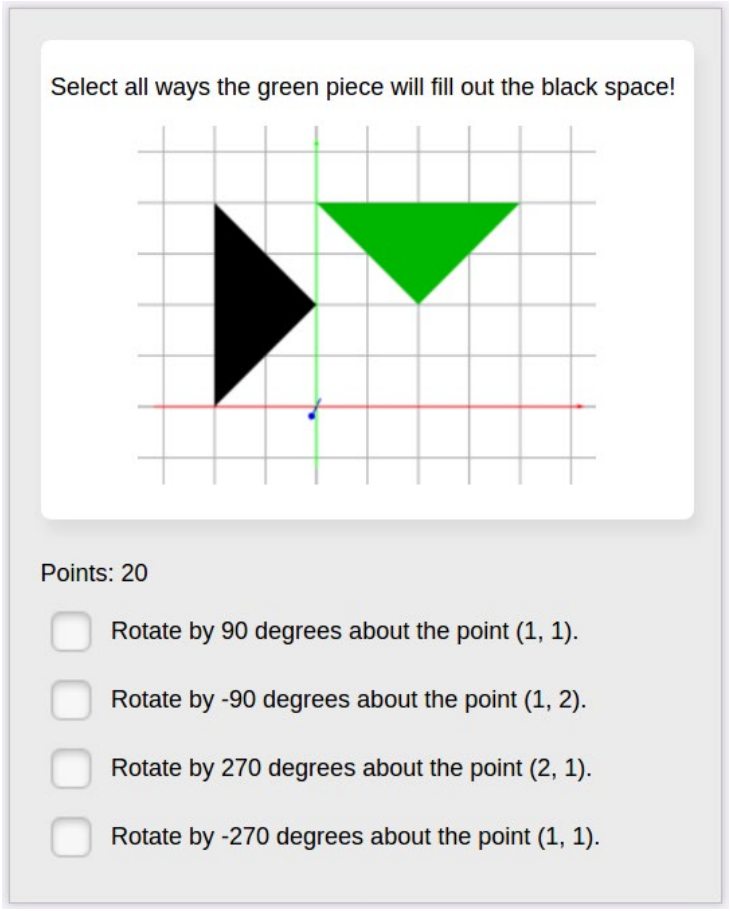


Karel, Turtle and 3D Modeling Courses Upgraded

We are pleased to announce that, after several months of work, new versions of the Karel, Turtle and 3D Modeling courses were finally released. The original Karel, Turtle and 3D Modeling courses will remain available until the end of June 2017.

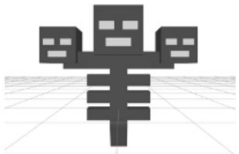
Quizzes

The game levels in the new courses remained almost intact, because not many changes were requested by teachers. An important addition are quizzes. Now there is a quiz at the end of every section (after ca. 7 game levels). The quizzes are related to the contents of the current section and they contain various types of questions including true/false questions, multiple choice questions, free answer questions and code completion questions. They are graded automatically.



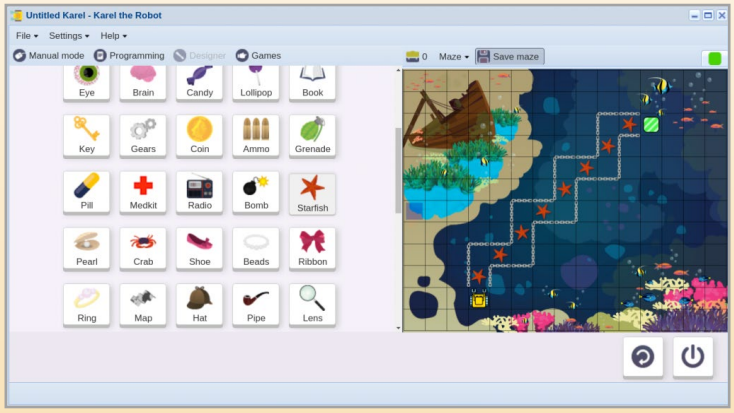
Creative Projects (Performance Tasks)

At the end of every section students will find a creative project where they can apply what they learned to create their own Karel mazes and games, their own Turtle designs, or their own 3D models. The projects come with detailed instructions and many examples where students can find inspiration. We expect that these projects will evolve and become more elaborate and thematically richer with time. Themes for the projects include Castles, Travels, Tangrams, Minecraft, Games, Sports, Lego, Furniture, and others. Here are three sample Minecraft designs:



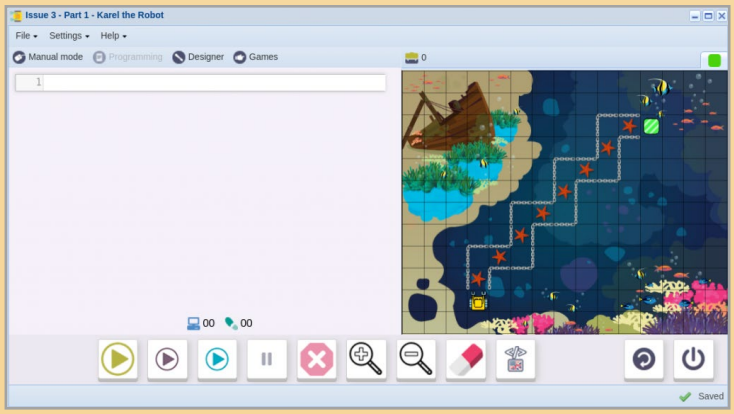
Create Your Own Karel Coding Game – Part 2

In Issue 3 of the NCLab Newsletter you learned how to create Karel mazes (this is the corresponding blog post). In the present lesson we will pick up where we left off, and explain how you can make your own Karel coding game. This is the maze that we built last time:



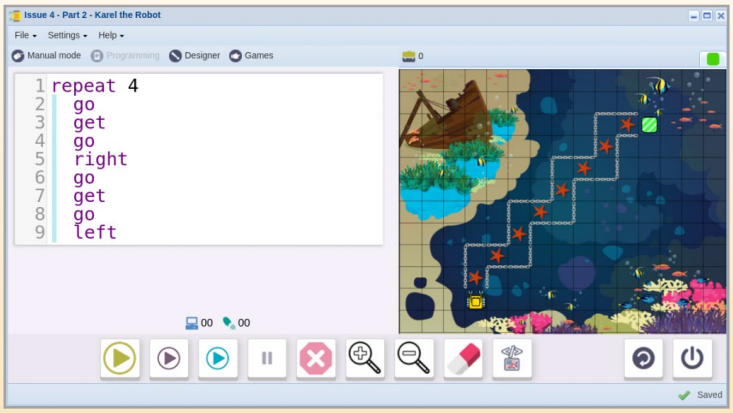
Let's switch back to the Programming Mode in the upper menu. As you can see, both the demo script and the generic description are still there:

Let's erase them both. The descriptive text cell has a closing button in its upper right corner once you move your mouse there. To erase the demo program, use the Eraser button:

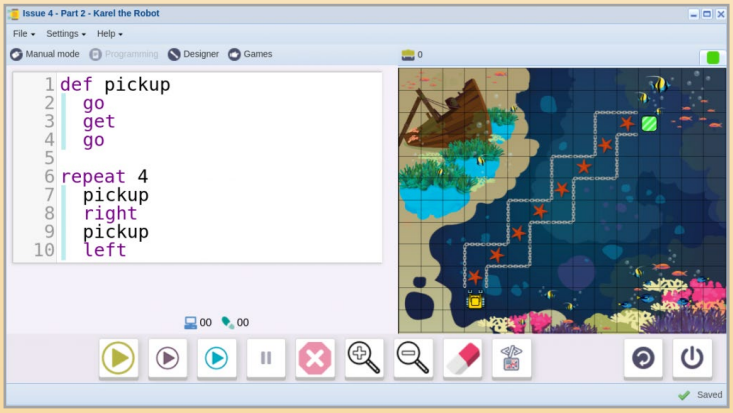


The next step is very important: SOLVE THE TASK YOURSELF. You would be surprised how often people create tasks which are too difficult or impossible to solve. Then, of course, the whole game becomes useless. This step prevents that. In this case, we need to write a program for Karel to get to his home square, collecting all starfish on the way. Here is a solution with 9 lines:

NCLab is member of CSTA

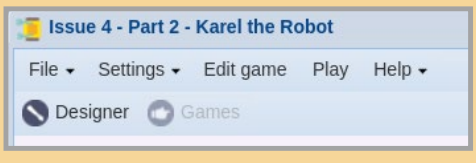


You can notice that the sequence of commands go-get-go is repeated in the code two times. That's not a good programming practice. One should create a new command for that. Here is the new code, introducing a new command "pickup". In this case, it does not make the code shorter though:



The good news is: YOUR GAME IS SOLVABLE! Great, let's finalize the game. For starters, go to the File menu. One of the options is "Convert to game":

Click on that option. An irreversible change will take place and the standard worksheet will be converted into a game worksheet with different menu items. Notably, you will see a new button "Edit game".



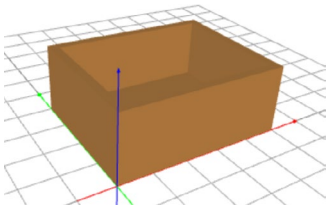
See more on the NCLab Blog

NCLab is not an affiliate program of the University of Nevada, Reno.

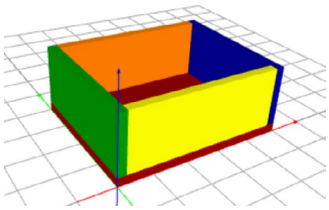
What Is Spatial Reasoning Exactly?

Taking the 3D modeling course in NCLab will not only make you strong in geometry, but it will also develop your spatial reasoning skills. But what is that, exactly? When you google for "spatial reasoning", you will find: "Spatial reasoning is a category of reasoning skills that refers to the capacity to think about objects in three dimensions and to draw conclusions about those objects from limited information."

That is quite abstract. And to some readers, the part about "thinking about objects in three dimensions" might be outright confusing. Spatial reasoning is about working with 3D objects with elegance and simplicity. Like in sports or when playing musical instruments: If someone is good at it, things happen seemingly effortlessly. But that is only true until you watch someone who lacks the skill. To illustrate what we mean, we prepared a small example about building a hollow box.



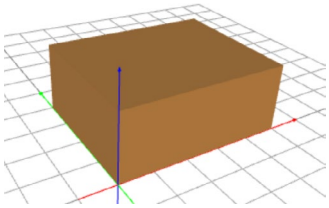
The box has outer dimensions 5 x 4 x 2 inches. The walls and the bottom are 1/4 of an inch thick. One way to view this object is as a union of five different rectangular prisms. The bottom 'b' and the sides 's1', 's2', 's3' and 's4'. In the following image, these objects are shown in different colors to make the point more clear:



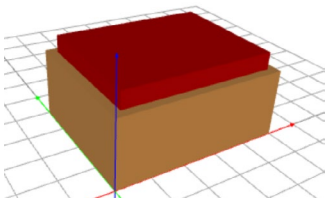
The design is then implemented accordingly. Using the command BOX to create five rectangular prisms, and then the command UNION to obtain the union of these five objects. This is the complete design:

```
b = BOX(5, 4, 0.25)
s1 = BOX(0, 0.25, 0, 4, 0.25, 2)
s2 = BOX(4.75, 5, 0, 4, 0.25, 2)
s3 = BOX(0.25, 4.75, 0, 0.25, 0.25, 2)
s4 = BOX(0.25, 4.75, 3.75, 4, 0.25, 2)
box = UNION(b, s1, s2, s3, s4)
COLOR(box,WOOD)
SHOW(box)
```

In summary, we needed to create five different objects and use one Boolean operation – set union – to obtain the result. Now somebody with more developed spatial reasoning skills might look at the same hollow box differently: There is a 5 x 4 x 2 inch rectangular prism



that has a cavity in the form of another rectangular prism. The latter is shown here in red color:



> ***"When debugging, novices insert corrective code; experts remove defective code."***
> — Richard E. Pattis

When the red object is subtracted from the original 5 x 4 x 2 rectangular prism, the same result as before is obtained using just two objects and one Boolean operation – set subtraction. Here is the corresponding code which is way more elegant:

```
box = BOX(5, 4, 2)
i = BOX(0.25, 4.75, 0.25, 3.75, 0.25, 2.5)
SUBTRACT(box, i)
COLOR(box,WOOD)
SHOW(box)
```

We hope that this example helped. There is much more to spatial reasoning than what we could cover here, therefore we will return to this subject in the future issues again.

Playing With Engineering At the Discovery Museum

Every second Wednesday of each month, the Discovery Museum in Reno puts on a Tech Night, providing families with a chance to interact with new technologies. NCLab recently partnered with the Museum to build a setting where kids can play with an engineering app to test properties of materials. Remember the balsa wood bridge that you built in 4th grade? You loaded it down with textbooks until it finally crashed. In the SparkLab, we had stations with different materials that could be used to build structures, and then we experimented with models on the computer. Kids were intrigued by the bent surfaces and stress points in the computer model, similar to what they saw with their constructed models.

Many thanks to Chris White, coordinator of the Spark!Lab and to Cesar, for running a smooth operation, complete with cool gadgets, robots, laptops, and boxes of building materials. NCLab looks forward to participating in another Tech Night. For more information about Tech Night and other events, visit the Discovery Museum website: https://nvdm.org/events/

Anyone can explore these free math, science, and engineering apps. Visit NCLab's free portal to watch instructional videos and launch apps at https:// nclab.com/free-portal/. You can also sign up for a free account with NCLab to receive access to all the apps in Creative Suite, plus cloud storage for your creations. NCLab is dedicated to bringing 21st century computing tools to everyone!

Computer Coding Workshop Just For Librarians!

Sponsored, in part, by the Nevada State Library, the NCLab self-paced courses and tools are designed to teach computer coding (and more) on any device, anywhere. Don't miss this day-long workshop that teaches the basics of how-to use NCLab and amplify the student and adult interest in computer science you see at your library. It's easy! The courses are selfpaced and self-graded, so users can learn independently. The courses teach coding, modeling, and deeper skills such as logical and visual spatial reasoning. In fact, the suite of tools can be used for everything from creating publications to solving problems in math, science, and engineering. Part of the State Library's professional development goals include supporting library staff ability to launch technology programs with improved professional confidence and enthusiasm. Do you have the NCLab application on computers at your library? If not, ask us!

LEARN ABOUT:

The benefits and pitfalls of game-based learning
NCLab's KarelJr, Tina, and 3D Modeling courses
How to integrate NCLab into clubs, camps, reading programs, and maker spaces
How the 4th Industrial Revolution is changing our lives!