Computer Science Principles

- *Big Idea 1*: Creativity
- *Big Idea 2*: Abstraction
- *Big Idea 3*: Data and Information
- *Big Idea 4*: Algorithms
- *Big Idea 5*: Programming
- *Big Idea 6*: The Internet
- *Big Idea 7*: Global Impact

Creativity

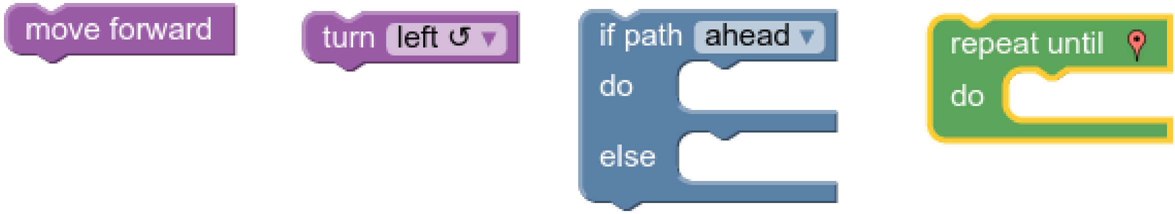
- Computing fosters the creation of artifacts and creative expression. Programming is a creative process
- Use the tools and techniques of computer science to create interesting artifacts that are enhanced by computation
- Examples:
  - How to solve the level 10 of Blockly Maze?
  - Create an app that plays the game of pong
  - Create an app that tracks the number of steps walked in a day
  - Create an app that augments Pokemon over reality!

Abstraction

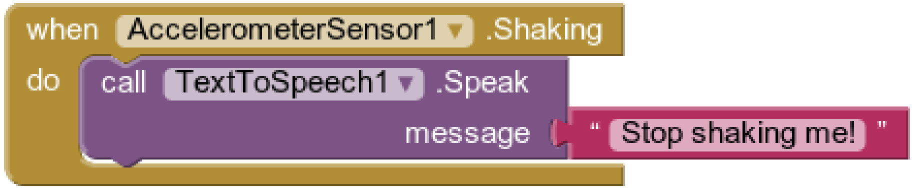
- *Abstraction* reduces information and detail to facilitate focus on relevant concepts.
  - Multiple levels of abstraction are used in computation
  - A combination of abstractions built upon binary sequences can be used to represent all digital data
  - Models and simulations use abstraction to raise and answer questions
- Examples:
  - A map, a model airplane, a floor plan
  - A button, a label, an image, a color
  - Binary numbers, integers, characters using Unicode
  - Integrated circuit, RAM (Random Access Memory) chip

Abstraction

- Code blocks are an example of abstraction



- AppInventor abstractions:
  - *AccelerometerSensor and TextToSpeech* are abstract blocks



```
when AccelerometerSensor1 .Shaking
do  call TextToSpeech1 .Speak
              message " Stop shaking me! "
```

Abstraction

- Which of the following is the most abstract?
  - The picture of a chair
  - The dictionary definition of a chair
  - The word “chair”
  - A physical chair
- Order the following by abstraction level
  - A RAM chip
  - An integrated circuit
  - The concept of “memory”

Data and Information

- Data and information facilitate the creation of knowledge. People use computer programs to process information to gain insight and knowledge. Computing facilitates exploration and the discovery of connections in information
- Computational manipulation of information requires consideration of representation, storage, security and transmission
- Examples:
  - *Lossless data compression*. How to represent the following data?

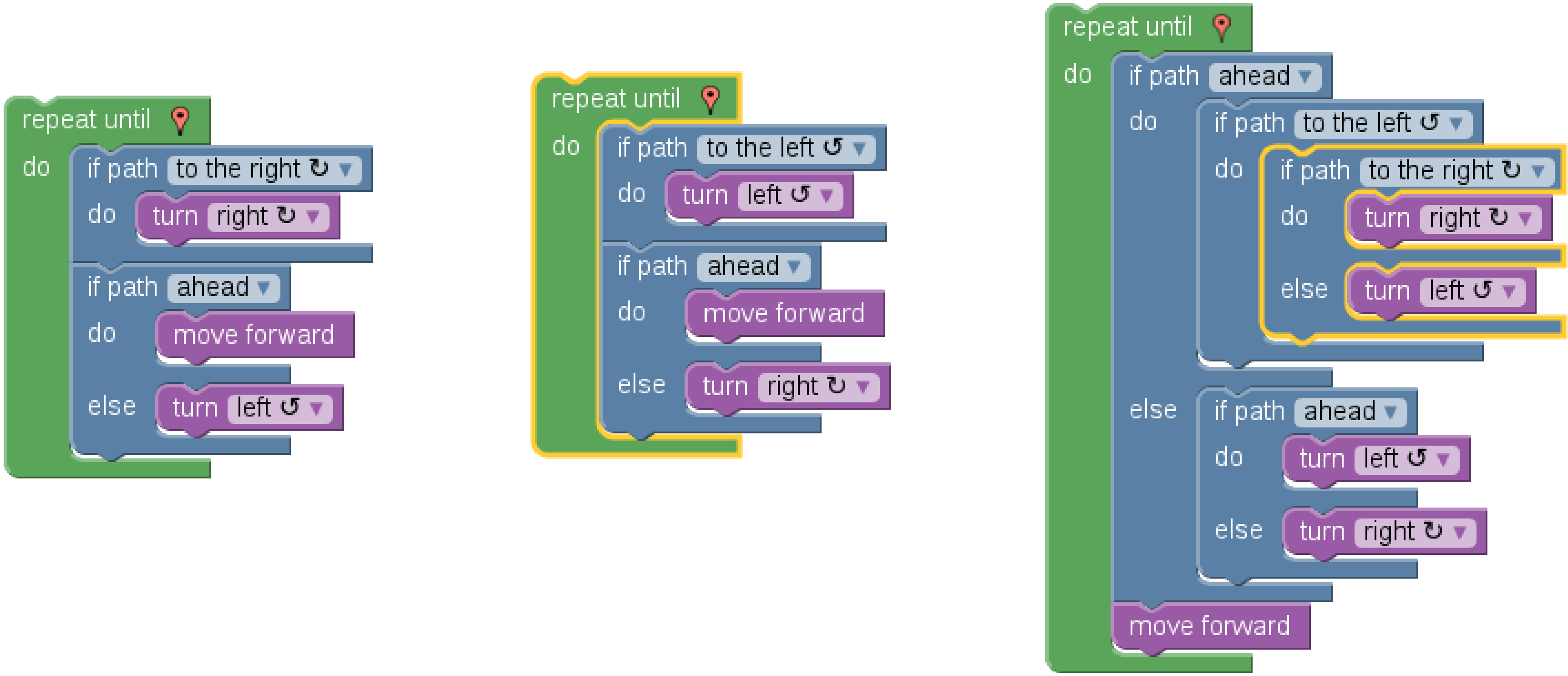
    b b b b b b b c c c c a a a a a a a a a
  - *Lossy compression*: MP3 music

Algorithms

- Algorithms are used to develop and express solutions to computational problems
- An algorithm is a precise sequence of instructions for a process that can be executed by a computer
- They are expressed using programming languages, and can solve many, but not all, problems
- They are evaluated both analytically and empirically

Recommended Reading: *Automate This: How Algorithms Came to Rule Our World*. Chris Steiner

Algorithms



```
repeat until 📍
do  if path to the right ↻
    do  turn right ↻
    if path ahead
    do  move forward
    else  turn left ↺
```

```
repeat until 📍
do  if path to the left ↺
    do  turn left ↺
    if path ahead
    do  move forward
    else  turn right ↻
```

```
repeat until 📍
do  if path ahead
    do  if path to the left ↺
        do  if path to the right ↻
            do  turn right ↻
            else  turn left ↺
    else  if path ahead
          do  turn left ↺
          else  turn right ↻
    move forward
```

Three algorithms for level 10 of Blockly Maze.

Programming

- Programming is a creative process that enables problem solving, human expression and creation of knowledge. It uses mathematical and logical concepts and is facilitated by appropriate abstractions

- Programs are developed and used by people, and they are written to execute algorithms

Internet

- The Internet pervades modern computing. It is a network of autonomous systems
- Characteristics of the Internet and the systems built on it influence their use
- Cybersecurity is an important concern for the Internet and those systems

Global Impact

- Computing affects communication, interaction and cognition. It enables innovation in nearly every field and has both beneficial and harmful effects
- Computing is situated within economic, social and cultural contexts
- Examples:
  - Protecting the privacy of sensitive data
- Recommended reading: *Blown to Bits* by Hal Abelson, Ken Ledeen, Harry Lewis (available in PDF, Kindle format as well as hardcopy)

Computational Thinking Practices

- P1: Connecting Computing
- P2: Creating Computational Artifacts
- P3: Abstracting
- P4: Analyzing problems and Artifacts
- P5: Communicating
- P6: Collaborating