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 get out of the level 10 of Blockly Maze?
  - Create an app that tracks the number of steps walked in a day
  - Create a visualization of a song
  - Write a program that composes original music or art or poetry!
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 song
- A button, a label, an image, a color
- Binary numbers, integers, characters using Unicode
Abstraction

- Code blocks are an example of abstraction
  
  ```
  move forward
  turn left
  if path ahead do
  else
  repeat until
  do
  ```

- AppInventor abstractions
  - `AccelerometerSensor` and `TextToSpeech` are abstract blocks

- `EarSketch` code to play a music sample on track 1 starting at measure 1 and stopping before start of measure 2

  ```
  fitMedia('RD_RNB_808MAINBEAT_10', 1, 1, 2)
  ```
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
Abstraction

Which of the following is the most abstract?

- The dictionary definition of a measure
- The word “measure”
- The image of a measure as a sound wave
- The sound file that plays one measure
- The code that generated the music
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:
  - Analog sound: 
  - Digital sound: \texttt{110111001010011101000010...}
Data and Information

- **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
  - **ALAC** (Apple Lossless Audio Codec), **FLAC** (Free Lossless Audio Codec)
  - *Lossy compression: MP3 music* drops or reduces parts of the music that are less audible to human ears
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

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 logical and mathematical concepts and is facilitated by appropriate abstractions.
- Programs are developed and used by people, and they are written to execute algorithms.

```python
from earsketch import *
init()
setTempo(120)

drum1 = ELECTRO_DRUM_MAIN_BEAT_008
drum2 = ELECTRO_DRUM_MAIN_BEAT_007

for measure in range (1, 9):
    fitMedia(drum1, 1, measure, measure + 0.5)
    fitMedia(drum2, 1, measure + 0.5 , measure + 1)

finish()
```
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.

Cloud computing is an important application of the internet.

Cybersecurity is an important concern for the Internet and those systems that are part of it.
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
  - Intellectual Property rights

- 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