

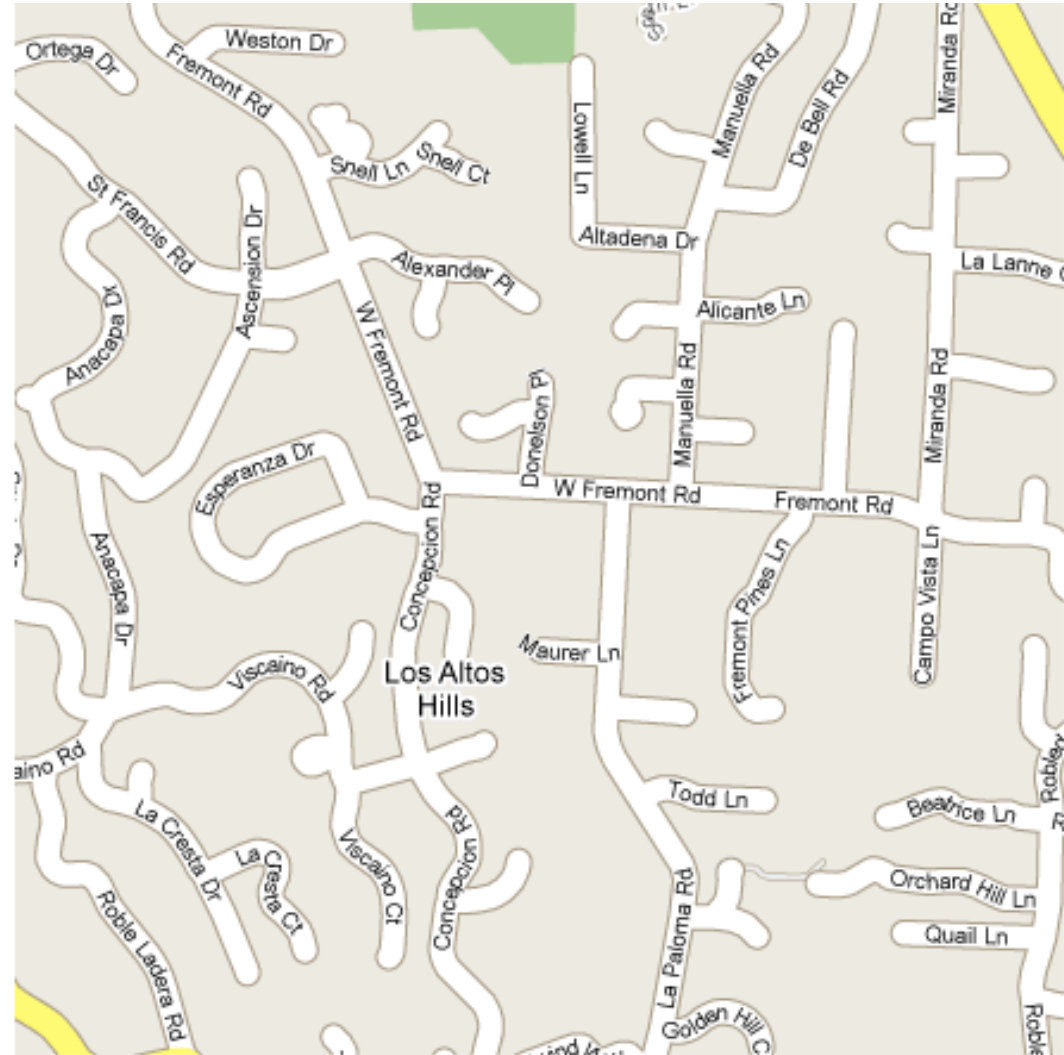
A decorative header at the top of the slide features four overlapping spheres. From left to right, they are light green, light blue, light red, and light yellow. The spheres are partially cut off by the top edge of the slide.

Computational Thinking

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Abstraction

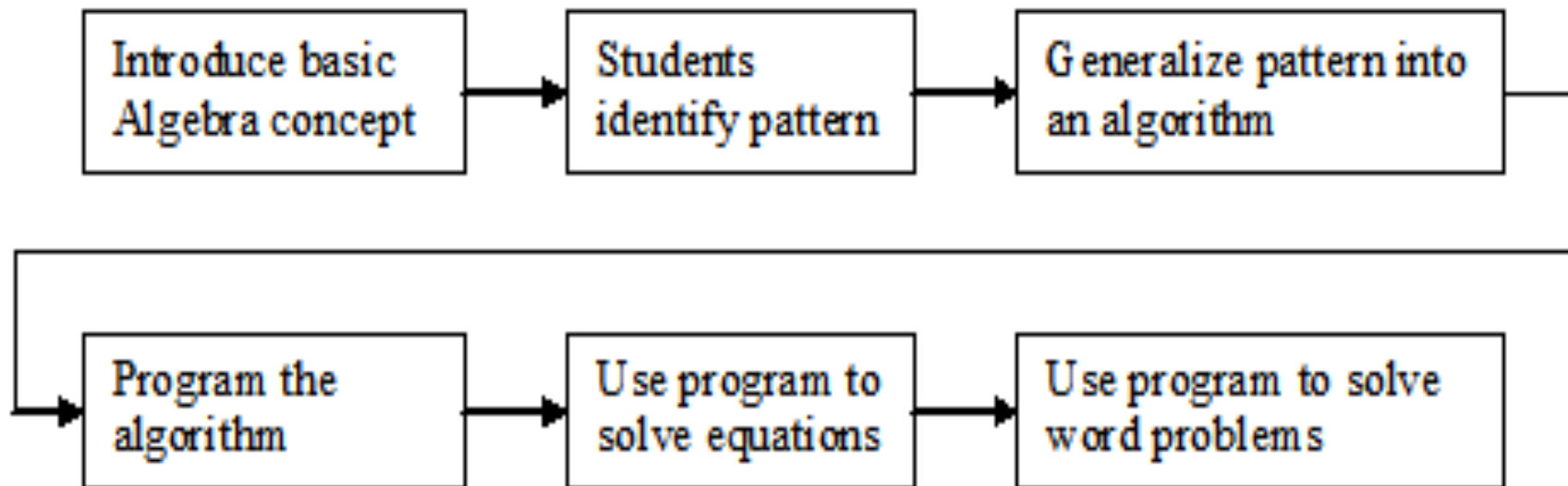


Patterns in behavior, process...



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- A decorative header at the top of the slide features four overlapping spheres: a green one on the left, and blue, red, and yellow ones on the right.
-
- Pattern Recognition
 - Pattern Generalization
 - Algorithm Design
 - Write a program

Patterns to Teach Algebra



Patterns in Algebra

- Pattern recognition

Pattern -> Program

$$x^2 + 6x + 9 = (x+3)(x+3)$$

$$x^2 + 8x + 16 = (x+4)(x+4)$$

Patterns in Algebra

- Pattern recognition

Pattern -> Program

$$x^2 + 6x + 9 = (x+3)(x+3)$$

$$x^2 + 8x + 16 = (x+4)(x+4)$$

- Pattern generalization

$$x^2 + (3+3)x + 3*3$$

$$x^2 + (4+4)x + 4*4$$

$$x^2 + (2k)x + k^2$$

Patterns in Algebra

- Algorithm to recognize the pattern
 - $x^2 + bx + c$ $x^2 + 8x + 16$
 - what are b and c? 8 16

Patterns in Algebra

- Algorithm to recognize the pattern
 - $x^2 + bx + c$ $x^2 + 8x + 16$
 - what are b and c? 8 16
 - $2 * 4 = 8$
 - $4 * 4 = 16$

Patterns in Algebra

- Algorithm to recognize the pattern
 - $x^2 + bx + c$ $x^2 + 8x + 16$
 - what are b and c? 8 16
 - $2 * 4 = 8$
 - $4 * 4 = 16$
 - does $b / 2 = \text{sqrt}(c)$?
 - yes: the factors are $(x + b/2)(x + b/2)$

Patterns in Algebra

- Program it !

```
b = input("what is b? ")  
c = input("what is c? ")
```

Patterns in Algebra

- Program it !

```
b = input("what is b? ")
```

```
c = input("what is c? ")
```

```
if b / 2 == sqrt(c):
```

```
    print "factors are: ", "(x + ", b / 2, ") squared"
```

Patterns in Algebra

- Program it !

```
b = input("what is b? ")
```

```
c = input("what is c? ")
```

```
if b / 2 == sqrt(c):
```

```
    print "factors are: ", "(x + ", b / 2, ") squared"
```

```
else:
```

```
    print "this equation does not fit the perfect  
square pattern"
```

More Examples

Exploring Computational Thinking

<http://www.google.com/edu/computational-thinking/lessons.html>

Percent Change



Program -> Pattern

$\text{pow}(x, y) = x^y$

Do the following:

```
>>> pow(2, 0)
```

```
>>> pow(894, 0)
```



Program -> Pattern

$\text{pow}(x, y) = x^y$

Do the following:

```
>>> pow(2, 0)
```

```
>>> pow(894, 0)
```

What's the pattern? Can you represent it?

```
pow(x, 0) = 1
```



Program -> Pattern

Do the following:

```
>>> pow(1, 0)
>>> pow(1, 5)
>>> pow(1, 894)
```



Program -> Pattern

Do the following:

```
>>> pow(1, 0)
>>> pow(1, 5)
>>> pow(1, 894)
```

What's the pattern? Can you represent it?

```
pow(1, y) = 1
```



Program -> Pattern

Do the following:

```
>>> pow(2, -1) == 0.5  
>>> pow(3, -1) == 0.333  
>>> pow(4, -1) == 0.25  
>>> pow(5, -1) == 0.2
```



Program -> Pattern

Do the following:

```
>>> pow(2, -1) == 0.5
>>> pow(3, -1) == 0.333
>>> pow(4, -1) == 0.25
>>> pow(5, -1) == 0.2
```

What's the pattern? Can you represent it?

```
pow(x, -1) = 1/x
```



Math, Science and more...

[Combinations with Repeats](#)

[Factorials with Names](#)

[Modeling in Biology](#)

[Present Participle](#)



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Questions?

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