Variables, Data Types, Formulas

Variable

- Symbolic name that represents a value within a computer program

Variable Declaration

- Variable Names
  - Legal Characters
    - A thru Z
    - a thru z
    - 0 thru 9
    - ‘_’
  - Other Rules
    - Cannot start with a number
    - Cannot contain spaces

Variable Declaration

- Legal Variable Name
  - Variable123
- Illegal Variable Name
  - 123Variable
  - Variable 123

Types of Data Types

- Primitive
  - AKA “Building block Data Type”
  - Supported data types provided by a programming language
  - Typically representations of numeric values such as numbers and characters
- Composite
  - Data type that is constructed of primitive data types
  - Can also contain already defined composite data types
  - Examples: Structures, Unions, Classes

Signed Vs Unsigned

- Signed
  - Primitive data type instance that allocates memory to store both positive and negative numbers
- Unsigned
  - Primitive data type instance that only allocated memory for positive numbers

Common Primitive Data Types

NOTE: These numbers are not consistent across languages and platforms

Variable Type	Memory Size	Signed Range	Unsigned Range
Integer	4 Bytes	-2,147,483,648 to 2,147,483,647	0 to 4,294,967,295
Short Integer	2 Bytes	-32,768 to 32,767	0 to 65,535
Character	1 Byte	N/A	0 to 255
String	1 Byte * n	N/A	0 to n
Boolean	1 Byte	N/A	TRUE (1) or FALSE (0)
Float	4 Bytes	Accurate within 7 Significant Figures	
Double	8 Bytes	Accurate within 15 Significant Figures	

Primitive Data Types: Integer

- A whole number
  - Boolean (4 Bits)
    - Values 1 (true) or 0 (false)
  - Byte (8 Bits)
    - Signed Range: −128 to +127
    - Unsigned Range: 0 to 255
  - Short Integer (16 Bits)
    - Signed Range: −32,768 to +32,767
    - Unsigned Range: 0 to 65,535
  - Integer (32 Bits)
    - Signed Range: −2,147,483,648 to +2,147,483,647
    - Unsigned Range: 0 to 4,294,967,295
  - Long Integer (64 Bits)
    - Signed Range: −9,223,372,036,854,775,808 to +9,223,372,036,854,775,807
    - Unsigned Range: 0 to 18,446,744,073,709,551,615

Primitive Data Types: Floating Point

- A rational number
  - Float (32 Bits)
    - 7 significant figures
      - 2 / 3 = 0.6666667
  - Double (64 Bits)
    - 15 significant figures
      - 2 / 3 = 0.666666666666667
  - Decimal (96 Bits)
    - 29 significant figures
      - 2 / 3 = 0.66666666666666666666666667

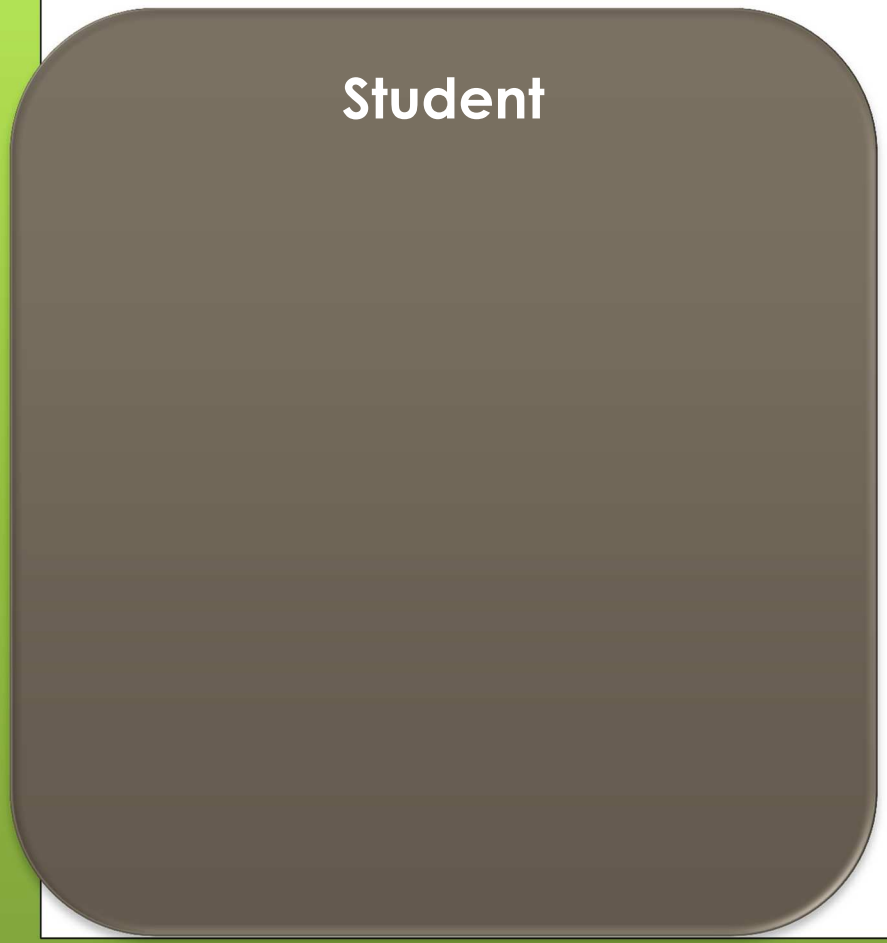
Primitive Data Types: Character

- A single ASCII or Unicode character
  - ASCII (8 Bits)
    - Range: 0 - 255
      - ‘ ’ = 32
      - ‘A’ = 65
      - ‘~’ = 126
  - Unicode (16 Bits)
    - Range: 0 – 65,535

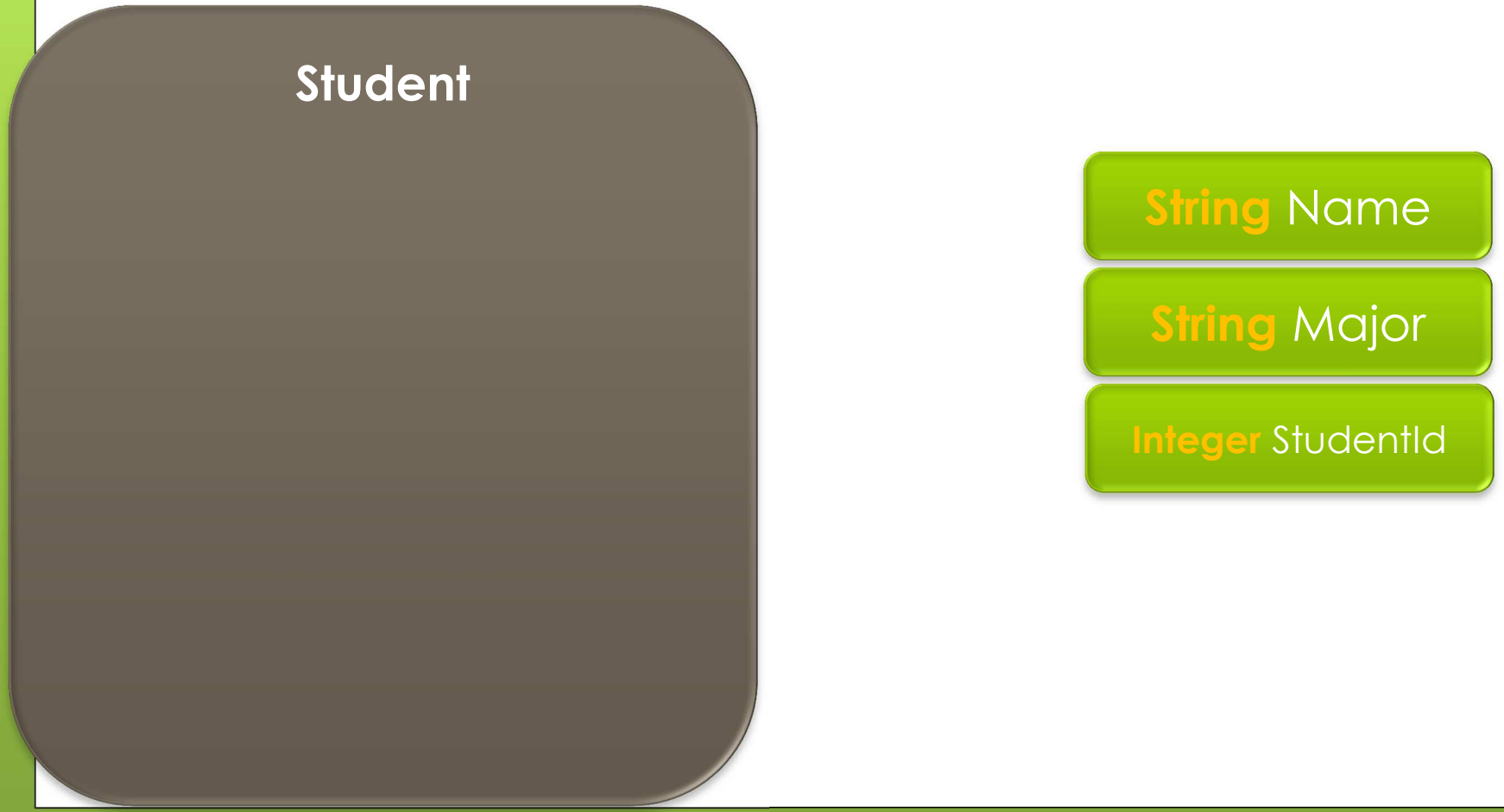
Primitive Data Types: String

- A sequence of characters
  - “This is a string!”

Composite Data Types



Composite Data Types



Composite Data Types

Basic Math Operators

Symbol	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulus

Expression	Value
1 + 2	3
100 * 3	300
10 / 2	5
5 % 2	1
1 – 10	-9

Comparison Operators

Symbol	Operation
==	Equal
!=	Not equal
<	Less than
<=	Less than or equal
>	Greater than
>=	Greater than or equal

Comparison Expression	Value
3 == 1	FALSE
(2 * 2) < (1 / 2)	FALSE
(9 * 1 – 3) >= (7 - 1)	TRUE
(2 % 2) < 2	TRUE
(1 + 4) <= 100	TRUE
(2 * 10) != 20	FALSE

Comparison Operators

Symbol	Operation
||	Or
&&	And

Comparison Expression	Value
(10 == 5) || (10 < 100)	(FALSE || TRUE) = TRUE
(10 == 5) && (10 < 100)	(FALSE && TRUE) = FALSE

Formulas

$X = 3 \times 10$	`X = 3 * 10`
$X = \frac{2}{3} \times 100$	`X = (2 / 3) * 100`
$X = 10^{2}$	`X = 10 ^ 2 or Power(10, 2)`
$X = \sqrt{10}$	`X = 10 ^ (1 / 2) or Power(10, ½)`
$A = \frac{(B+b) \times h}{2}$	`A = ((B + b) * h) / 2`

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Formulas

$$z = ax^2 + bx + c$$

```
z = a * Power(x, 2) + b * x + c
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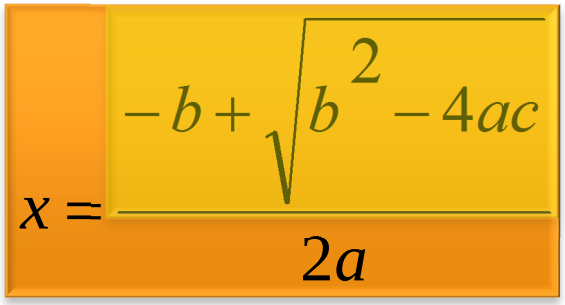
Formulas

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

```
x = (-b + Power(Power(b, 2) - 4 * a * c, ½)) / (2 * a)
```

Formulas

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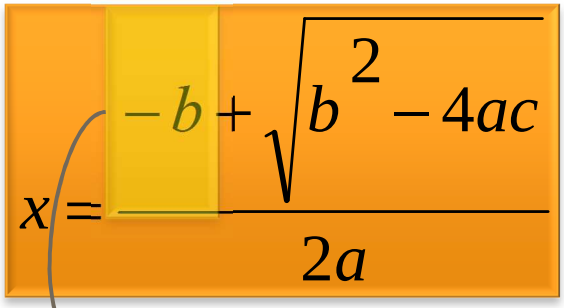
Formulas

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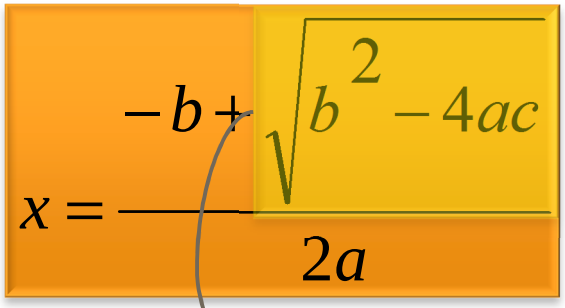


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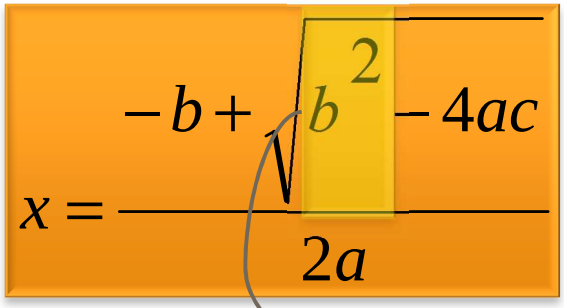


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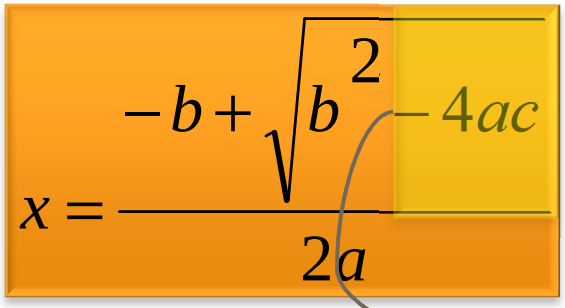


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x = (-b + Power(Power(b, 2) - 4 * a * c, ½)) / (2 * a)
```

Typecasting

- Converting between data types
  - One data type inherits the properties of another

Where to use Typecasting

```
Integer x = 4
Integer y = 10

Double z = y / x

z = 2
```

Where to use Typecasting

```
Integer x = 4
Integer y = 10

Double z = (Double)y / (Double)x

z = 2.5
```

Variable Declaration

- C++
  - `int Number = 1234;`
  - `char c = 's';`
  - `string word = "Hello!";`
  - `bool isTrue = true;`
  - `double pi = 3.14`

Variable Declaration

- Visual Basic (*Beginners All-Purpose Symbolic Instruction Code*)
  - `Dim Number As Integer = 1234`
  - `Dim c As Char = "s"`
  - `Dim word As String = "Hello!"`
  - `Dim isTrue As Boolean = true;`
  - `Dim pi As Double = 3.14`

Variable Declaration

- PERL / PHP
  - `$Number = 1234;`
  - `$word = “Hello!”;`
  - `$isTrue = true;`
  - `$pi = 3.14;`

Variable Declaration

- TCL
  - `set Number 1234;`
  - `set word “Hello!”;`
  - `set isTrue 1;`
  - `set pi 3.14;`

The End?