COMP110: Principles of Computing

asic Principles for Computation

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Programming languages and paradigms

What is a programming language?

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- A **program** is a sequence of instructions for a computer to perform a specific task
- A **programming language** is a formal language for communicating these sequences of instructions

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- There are hundreds of programming languages, each better suited to some tasks than others
- Sometimes your choice is dictated by your choice of platform, framework, game engine etc.
- To become a better programmer (and maximise your employability) you should learn several languages (but one at a time!)

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- High level languages trade efficiency for ease of programming
- Lower level languages were once the choice of game programmers, but advances in hardware mean that higher level languages are often a better choice

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- **Declarative**: does not define the control flow of a program, but rather defines logical relations

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- Purely **functional** languages are mainly used in academia, but favoured by some programmers
- Purely **declarative** languages have uses in academia and some special-purpose languages

Machine code

```
0000000 4d 5a 90 00 03 00 00 00 04 00 00 00 ff ff 00 00
0000010 b8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00
0000020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0000030 00 00 00 00 00 00 00 00 00 00 00 00 30 01 00 00
0000040 0e 1f ba 0e 00 b4 09 cd 21 b8 01 4c cd 21 54 68
0000050 69 73 20 70 72 6f 67 72 61 6d 20 63 61 6e 6e 6f
0000060 74 20 62 65 20 72 75 6e 20 69 6e 20 44 4f 53 20
0000070 6d 6f 64 65 2e 0d 0d 0a 24 00 00 00 00 00 00 00
0000080 75 99 69 bc 31 f8 07 ef 31 f8 07 ef 31 f8 07 ef
0000090 a2 b6 9f ef 3c f8 07 ef 2a 65 99 ef 70 f8 07 ef
00000a0 2a 65 ac ef 7f f8 07 ef 2a 65 ad ef ec f8 07 ef
00000b0 5e 8e ac ef 32 f8 07 ef 16 3e 6a ef 35 f9 07 ef
00000c0 f2 f7 58 ef 33 f8 07 ef f2 f7 5a ef 35 f8 07 ef
00000d0 f2 f7 67 ef 30 f8 07 ef 38 80 83 ef 30 f8 07 ef
00000e0 38 80 94 ef 14 f8 07 ef 31 f8 06 ef 55 fa 07 ef
00000f0 2a 65 a8 ef 02 f9 07 ef 2a 65 9c ef 30 f8 07 ef
0000100 2a 65 9d ef 30 f8 07 ef 2a 65 9a ef 30 f8 07 ef
0000110 52 69 63 68 31 f8 07 ef 00 00 00 00 00 00 00 00
0000120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0000130 50 45 00 00 4c 01 03 00 5f 68 9a 57 00 00 00 00
0000140 00 00 00 00 e0 00 03 01 0b 01 0a 00 00 f0 10 00
0000150 00 40 00 00 00 30 37 00 a0 25 48 00 00 40 37 00
0000160 00 30 48 00 00 00 40 00 00 10 00 00 00 02 00 00
0000170 05 00 01 00 00 00 00 00 05 00 01 00 00 00 00 00
0000180 00 70 48 00 00 10 00 00 00 00 00 00 02 00 00 81
0000190 00 00 10 00 00 10 00 00 00 00 10 00 00 10 00 00
00001a0 00 00 00 00 00 10 00 00 00 50 3d 26 00 4b 00 00
00001b0 70 62 48 00 80 04 00 00 00 30 48 00 70 32 00 00
00001c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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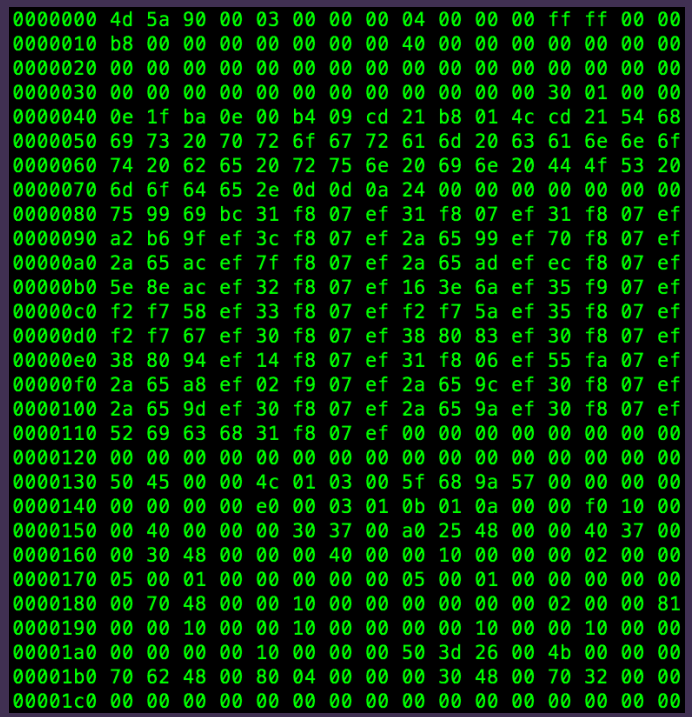
Machine code



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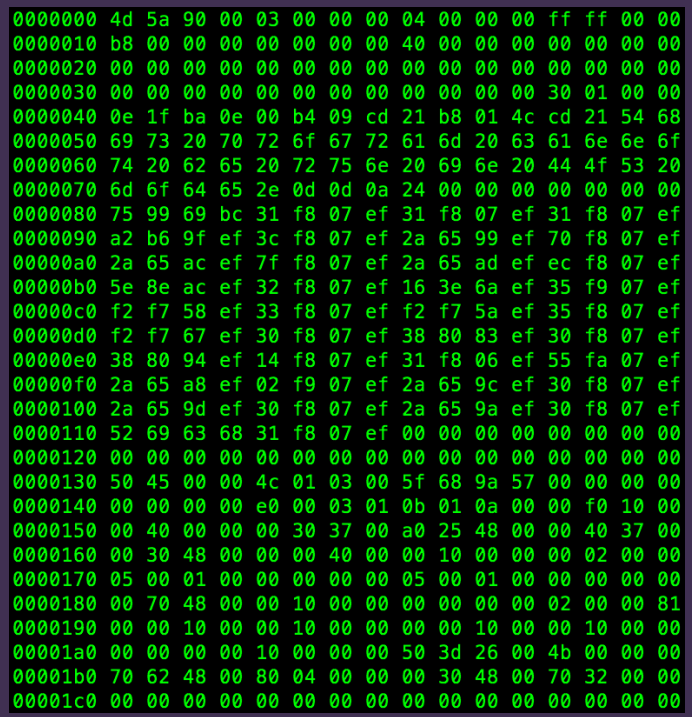

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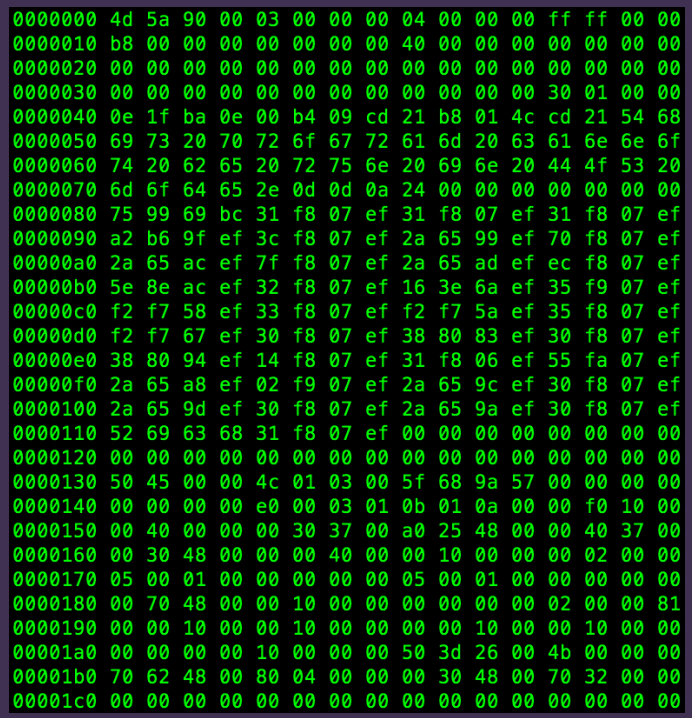

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- More on this later in the module
- Nobody has actually written programs in machine code since the 1960s...

Assembly language

```
section     .text
global      _start

_start:

    mov     edx,len
    mov     ecx,msg
    mov     ebx,1
    mov     eax,4
    int     0x80

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- ... but difficult to use as there is no **abstraction**
- Also not portable between CPU architectures

C++

```
#include "stdafx.h"
#include "GameObject.h"
#include "CoinGame.h"

GameObject::GameObject(CoinGame* game, Texture* sprite)
	: game(game), sprite(sprite), isDead(false)
{
	x = rand() % CoinGame::WINDOW_WIDTH;
	y = rand() % CoinGame::WINDOW_HEIGHT;
}


GameObject::~GameObject()
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}

void GameObject::render(SDL_Renderer* renderer)
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	sprite->render(renderer, x, y, CoinGame::SPRITE_SIZE, CoinGame::SPRITE_SIZE);
}

bool GameObject::checkCollision(int otherX, int otherY)
{
	double distance = sqrt(pow(otherX - x, 2) + pow(otherY - y, 2));
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- Also used by developers of operating systems and embedded systems, but falling out of favour with other software developers

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There are many others, but these are the most commonly used in game development

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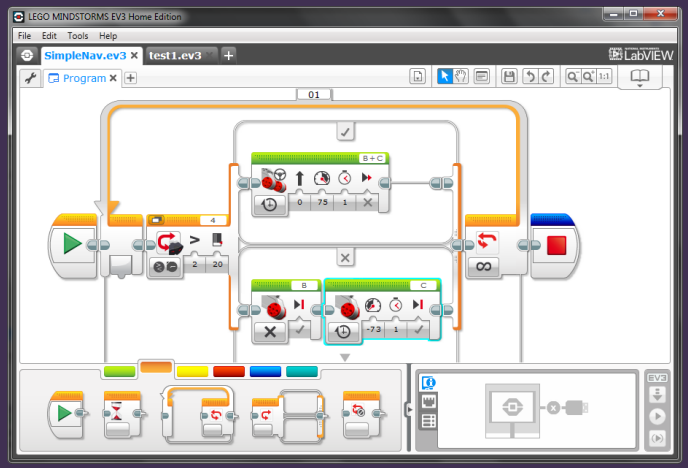
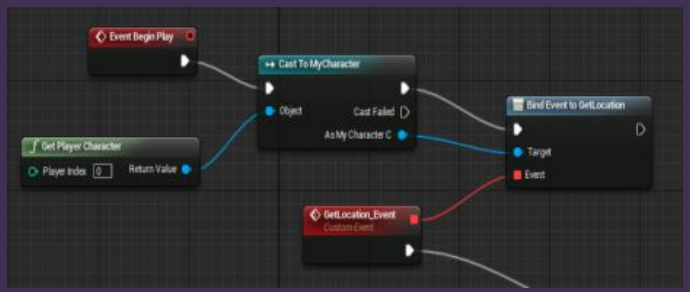
- GML (GameMaker)

Visual programming languages





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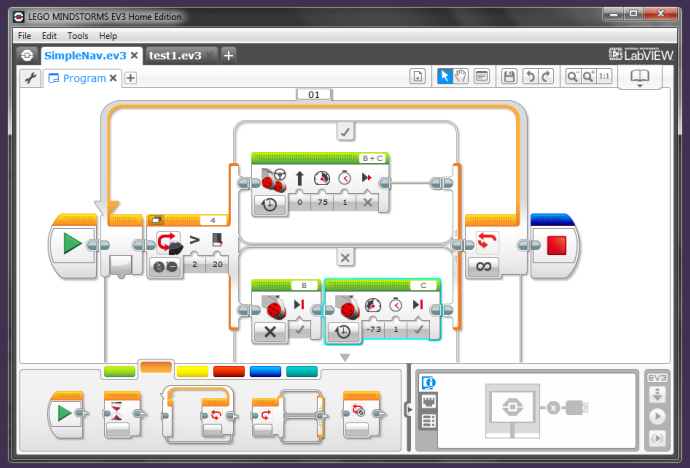
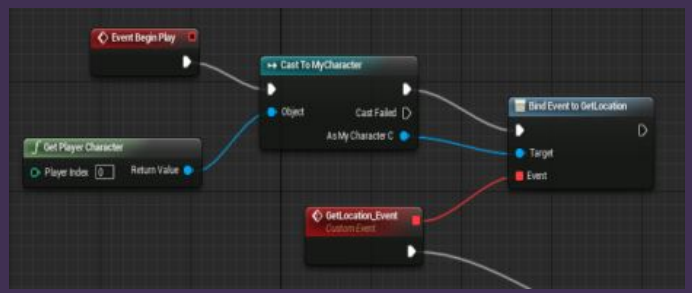
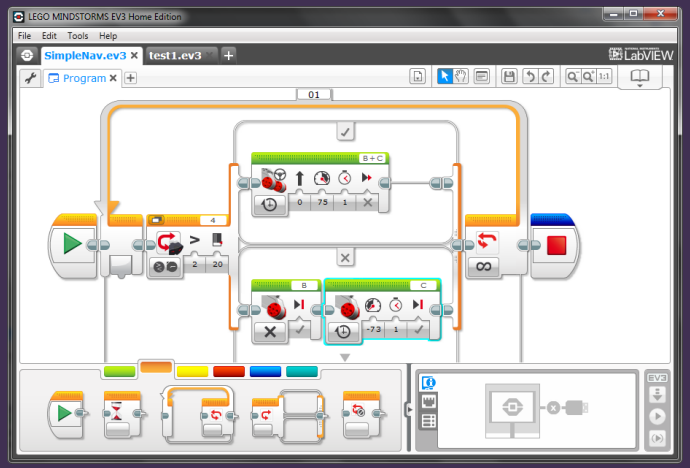
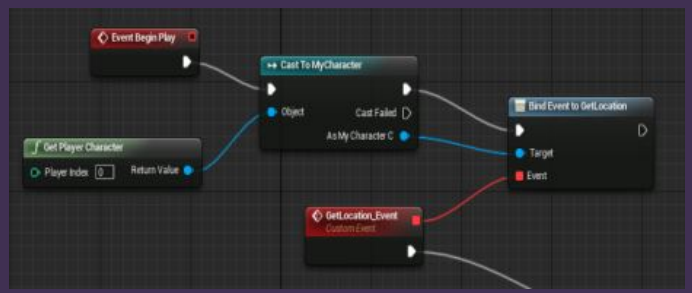




Based on connecting graphical blocks rather than writing code as text

Visual programming languages

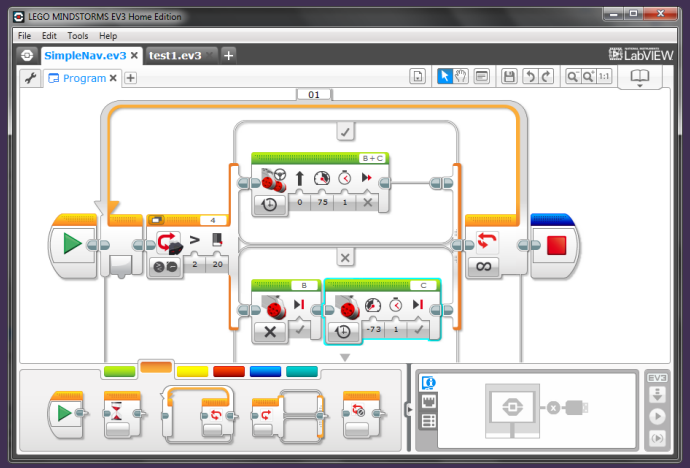


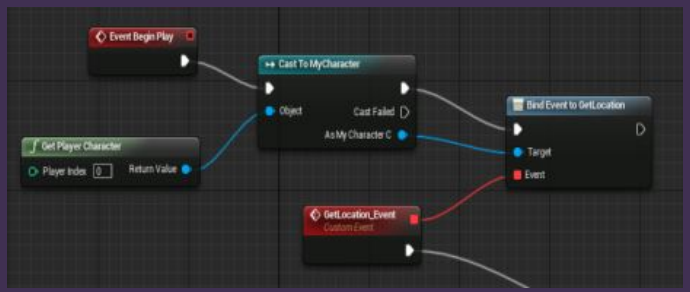


Based on connecting graphical blocks rather than writing code as text

- Scratch (used for teaching in school)

Visual programming languages





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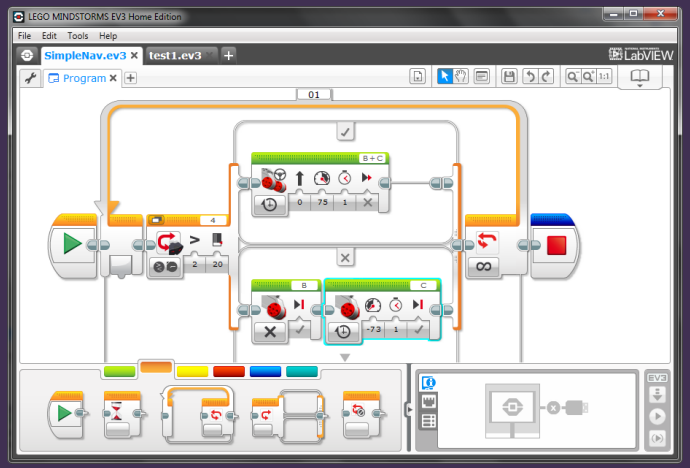

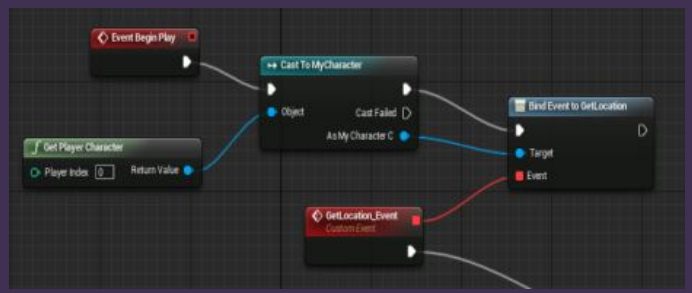

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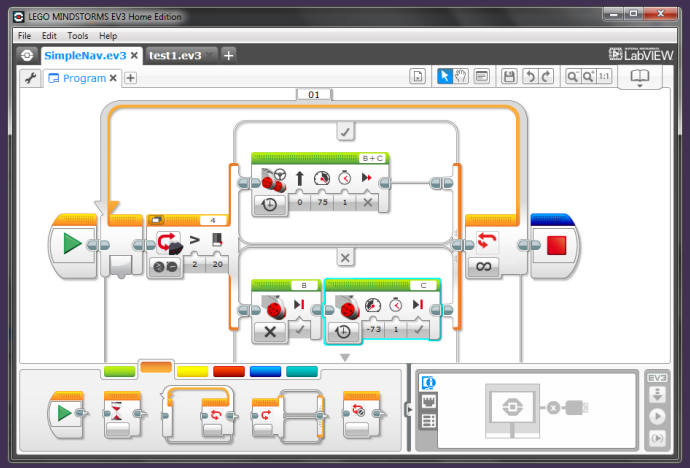

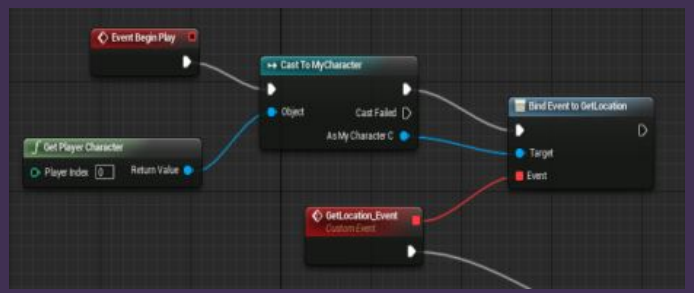

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Note: despite the name, Microsoft Visual Studio is **not** a visual programming environment!

Special purpose languages

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- SQL (database queries)

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- GLSL, HLSL (GPU shader programs)

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- GLSL, HLSL (GPU shader programs)
- LEX, YACC (script interpreters)

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- LaTeX, Markdown (documentation)
- XML, JSON (data storage)

Which programming language is most popular?

http://githut.info

“Family tree” of programming languages

https://www.levenez.com/lang/lang.pdf

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Computing professionals

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- Get into groups of 4–5

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- How many can you think of?
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- Discuss for **15 minutes**