

Compilation process (cont.)

Syntax analysis

- Tokens are checked to see if they match the spelling and grammar expected, using standard language definitions. This is done by parsing each token to see if it uses the correct syntax for the programming language.
- If syntax errors are found, error messages will be produced.

Term	Definition
Parsing	Analysing a string of tokens
Syntax	The rules for the structure of statements in a programming language

Semantic analysis

- Variables are checked to ensure that they have been properly declared and used.
- Variables are checked to ensure that they are of the correct data type – real values are not being assigned to integers.
- Operators are checked to ensure that they are valid for the type of variable being used.

Code generation and optimisation

- Machine code is generated.
- Code optimisation may be used to ensure that the object code is as efficient, fast and less resource intense as possible.

op	target address	
2	1024	decimal
000010	00000 00000 00000 10000 000000	binary

Programming errors

When an error occurs in code, the program fails to compile or to run. Error messages are displayed to help the programmer diagnose what has gone wrong.

```
Python 3.8.1 Shell
Python 3.8.1 (v3.8.1:1b293b6006, Dec 18 2019, 14:08:53)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: /Users/jengillies/Downloads/program 2/program.py =====
Welcome to Parkwood Vale Athletics Club.
Main Menu, type in which option you would like:
Option 1: Create new member
Option 2: Renew membership
Option 3: How many days left until member needs to pay
Option 4: Reminder for renewal
Option 5: Check for overdue membership
Option 6: Cancel membership.
ValueError: invalid literal for int() with base 10: 'A'
>>>
```

Syntax errors

A syntax error is an error in the source code of a program. As the code in a computer programs must follow strict syntax rules to compile correctly, any aspects of the code that do not follow the syntax of the programming language will cause a syntax error.

Incorrect: Whale x < 6 Correct: While x < 6

Runtime / execution error

A runtime error only happens when the code is run. It is an error that is difficult to foresee before the code is run.

A typical runtime error is an attempt to divide a number by zero which will cause the program to crash.

Logical error

A logical (logic) error is a mistake in a program's source code that results in incorrect or unexpected behaviour. An example would be using the wrong operator in a calculation.

Linking error

An error that occurs when a programmer calls a function within a program, but the correct library has not been linked to the program.

An example would be when the code uses the square root function that has not been linked to the program.

Rounding error

A rounding error is the difference between a rounded-off numerical value and the actual value. A rounded quantity is represented by a numeral with a fixed number of allowed digits.

Actual value: 3.1429 Rounded value: 3.14

Truncation error

Truncation error is the difference between a truncated value and the actual value. A truncated quantity is represented by a numeral with a fixed number of allowed digits, with any excess digits "chopped off".

Actual value: 7.99 Truncated value: 7

This creates an error of - 0.99.

Example Question

The following program is intended to calculate a total mark achieved by one student who has taken 4 tests. The program contains two errors.

```
Total is integer
Count is integer
Mark is integer
Total = 0
for Count = 1 to 4
    input Mark
    Total = Total - Mark
next Count
```

Name the errors and write down the correct code.

```
Syntax error - input Mark
Logic error - Total = Total + Mark
```