Programing Techniques

What the Specification says

Explain how functions, procedures and their related variables may be used to develop a program in a structured way, using stepwise refinement;
Describe the use of parameters, local and global variables as standard programming techniques;
Explain how a stack is used to handle procedure calling and parameter passing;
Explain the need for, and be able to create and apply, BNF (Backus-Naur form) and syntax diagrams;
Explain the need for reverse Polish notation;
Convert between reverse Polish notation and infix form of algebraic expressions using trees and stacks.

Notes

Stepwise Refinement
This is where a complex problem is broken down into smaller and smaller sub-problems until all the sub-problems can be solved easily.

Functions and Procedures
- A procedure is a small section of code designed to perform a specific definable task, and may or may not return a single value.
- A function is a block of code which performs a single task or calculation and returns a single value. They use local variables.

How Functions and Procedures can Develop Programs in a Structured way
- Each module can be written as a functional procedure
- Modules can be tested individually
- Library routines can be used
- The code is reusable
- Main program consists of calls to functions/procedures which may be nested

Parameters
- A parameter is (information about) an item of data supplied to a procedure or function which may be passed by reference or by value, and is used as a local variable.

Local Variables
- Local variables exist only in the block which they are declared, they can only be accessed in that part.
- The data contained in the variable is lost when the execution of that part of the program is complete
- The same variable names can be used in different modules
- This means that different programmers do not have to worry about variables overwriting themselves.

Global Variables
- A variable that is defined at the start of a program and exists throughout program including functions/procedures.
- Allows data to be shared between modules
- Overridden by local variables with the same name

Stacks
- When a procedure or function is called the program needs to know where to return to when the execution is complete. The return address must be known.
- Also these functions and procedures may call more functions and procedures, all of these will have return addresses, which must be stored, along with the order.
- This is done using a stack
- When values are read, they are popped of the stack, but they remain in the stack.
- The stack pointer can be moved then items are popped of or pushed on.

The Purpose of the Stack

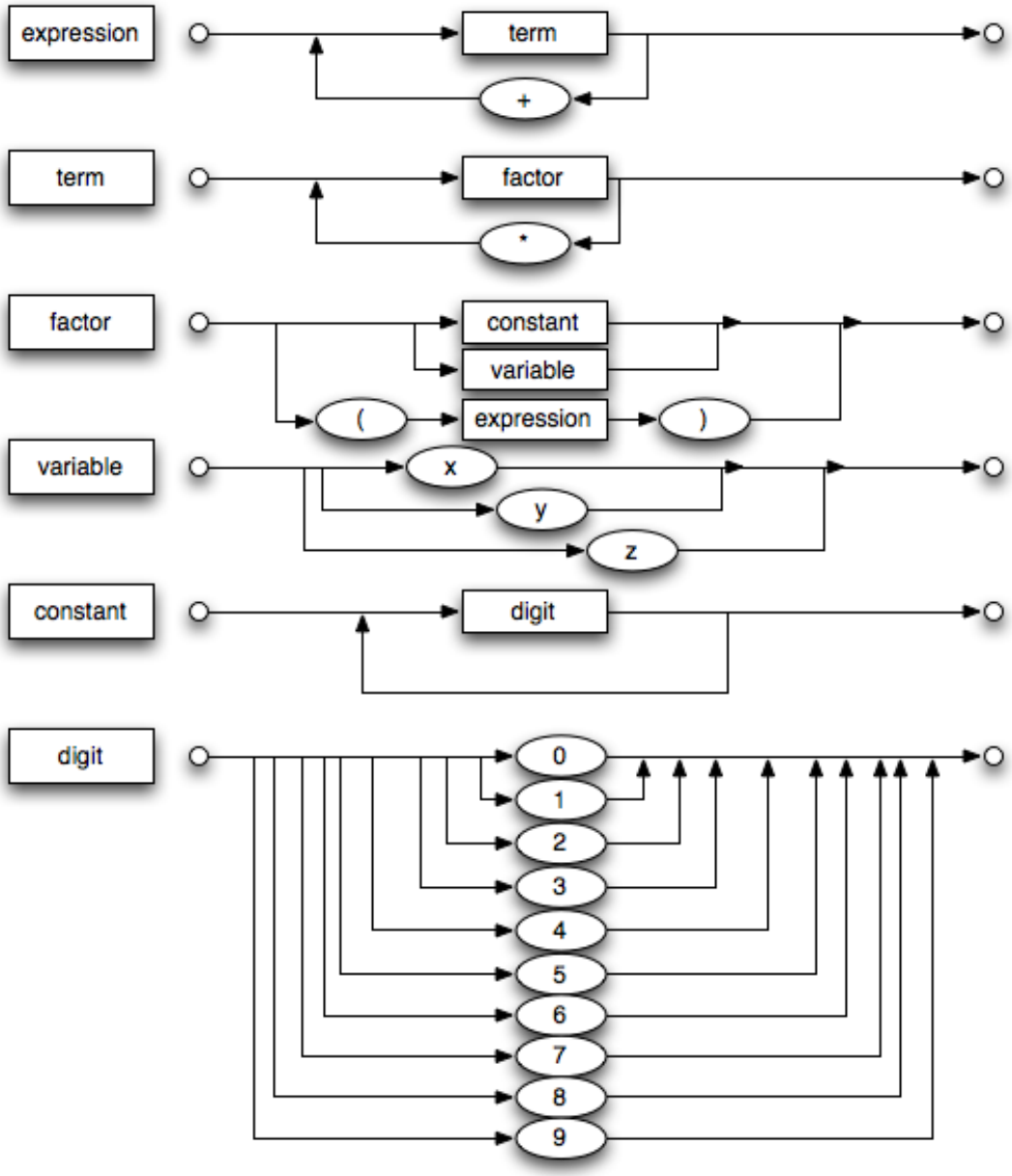
- So program can return correctly when procedure has been completed/store return address
- Allows data to be transferred

Backus-Naur Form

- BNF is to unambiguously define the syntax of a computer language

BNF and Syntax Diagrams Examples

```
<expression> ::= <term> | <expression> "+" <term>
<term>       ::= <factor> | <term> "*" <factor>
<factor>     ::= <constant> | <variable> | "(" <expression> ")"
<variable>   ::= "x" | "y" | "z"
<constant>   ::= <digit> | <digit> <constant>
<digit>      ::= "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```



Past Paper Questions and Answers

What type of traversal should be used to obtain reverse polish from a binary tree?

post-order (traversal)

State a data structure that may be associated with reverse polish notation

stack
binary tree

What symbol used in mathematical expressions is not required in reverse polish?

bracket

How can functions and procedures develop a program in a structured way?

each module can be written as a functional
procedure…
…which can be tested individually
library routines
code is reusable
main program consists of calls to
functions/procedures…
…which may be nested

Compare the use of local and global variables and parameters

local variables
a variable defined within one part of program…
…& is only accessible in that part
data contained is lost when execution of that part of
program is completed
the same variable names can be used in different modules
global variables
a variable that is defined at the start of a program…
& exists throughout program…

…including functions/procedures
allows data to be shared between modules
overridden by local variables with the same name
parameters
information about an item of data…
…supplied to a function or procedure
can be passed by reference or by value
used as a local variable

What data structure is used when procedures are called during program execution?

stack

What is the purpose of using a stack?

so program can return correctly when procedure has
been completed/store return address
allows data to be transferred

State the need for BNF

to unambiguously define the syntax of a computer language

What's the use of functions, procedures and step-wise refinement when developing a program?

function:
block of code…
…which performs a single task/calculation…
returns a single value
uses local variables
procedure:
block of code…
…which performs a task
…which may or may not produce a single value
uses local variables

stepwise refinement:
breaks a problem into sections…
…which become progressively smaller…
…until each module can be written as a single procedure/function
each module can be tested separately
library routines can be used

What data structure is used to handle procedure calling and parameter passing?

stack

What's a parameter?

(information about) an item of data…
…supplied to a procedure or function
may be passed by reference or by value
used as a local variable

What is the purpose of a syntax diagram?

to define terms unambiguously (for a computer language)

What is an advantage of reverse polish over infix notation?

any expression can be processed in order (left to right)
no rules of precedence are needed/no brackets are needed/unambiguous