12.2 Structure Charts

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

KEY WORDS structure chart • parameter • BYREF • iteration • selection

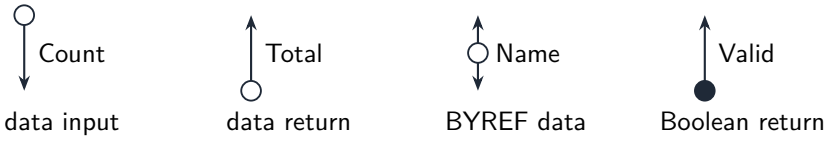
Objective

Read, complete and draw exam structure charts, and derive typed pseudocode module headers from them. This sheet prepares you for past-paper set **12.2 Structure Charts**.

1 Key knowledge and worked examples

■ Key knowledge: modules and parameter notation

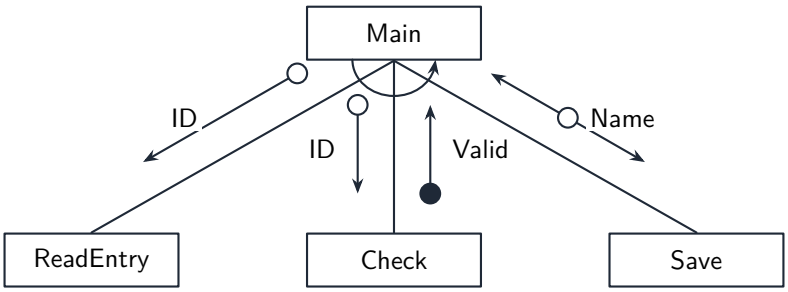
A **structure chart** shows a program's hierarchical decomposition into modules and the parameters passed between them. Rectangles name modules. An ordinary line connects a caller above to a module it calls below; it is not a parameter arrow.



- An **open circle** marks a data coupling, such as INTEGER, REAL or STRING. A **filled circle** marks a control coupling, such as BOOLEAN.
- A separate labelled arrow points **towards the receiving module**. A downward arrow passes an input; an upward arrow carries a returned value.
- A two-way arrow with a circle represents a parameter passed **BYREF** . A procedure can update the caller's variable this way; this does not make it a function.
- A **function** returns a value and its header includes `RETURNS` and the type. A **procedure** has no function return value. Parameter names and types go inside parentheses; no parameters means `()`.
- A return label belongs to the arrow, not in the function's parameter list. Use the supplied type information: an open circle does not distinguish INTEGER from STRING.

■ Worked example: chart to headers and iteration

`ID` is INTEGER and `Name` is STRING. Read the direction and circle of every coupling:

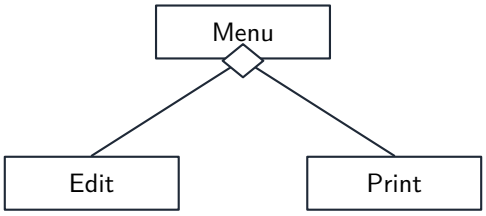


1. `ReadEntry` receives ID and has no return arrow, so it is a procedure with one INTEGER parameter.
2. `Check` receives ID and returns the Boolean Valid, so it is a function returning BOOLEAN.
3. `Save` has a two-way data coupling for Name, so it is a procedure with a BYREF STRING parameter.

```
PROCEDURE ReadEntry(ID : INTEGER)
FUNCTION Check(ID : INTEGER) RETURNS BOOLEAN
PROCEDURE Save(BYREF Name : STRING)
```

The curved arrow means **Main repeatedly calls ReadEntry, then Check, then Save, in that order**. An exam explanation needs the caller, the modules, the order and repetition, not just the word 'loop'.

■ Key knowledge: selection and building a chart



The diamond means **Menu calls either Edit or Print**, chosen at run time. It does not mean that both modules are always called.

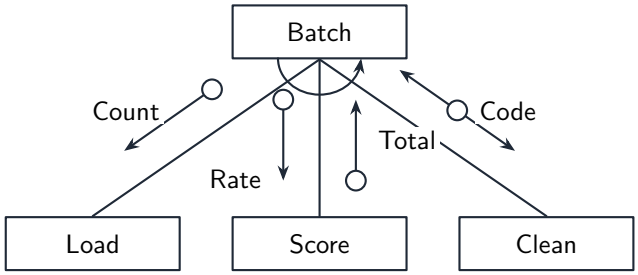
■ Worked example: headers to a chart

Suppose the notes say Main repeatedly calls ReadEntry, then Check, then Save, with the three headers above. First put Main above three rectangles in that order and connect the hierarchy. Add an open-circle ID arrow down to Read. Add ID down to Check and a filled-circle return arrow up. Add a two-way open-circle Name arrow beside Save's link. Finally draw the iteration arc beneath Main across the three child links. This produces the worked chart above.

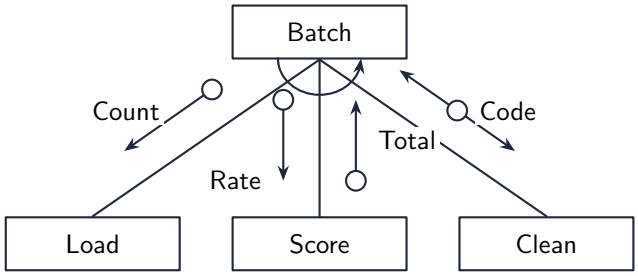
Before handing in: check every module, caller, parameter, direction, circle, return value, selection and iteration symbol against the notes. Do not add calls that the notes do not specify.

2 Practice

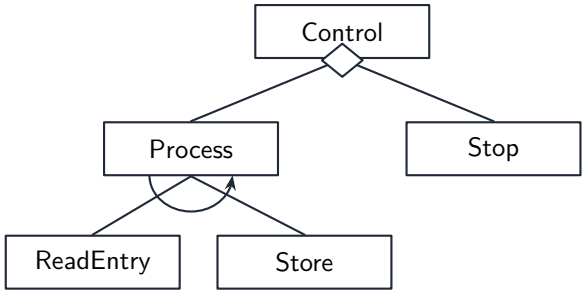
2.1 In the chart, Count is INTEGER, Rate and Total are REAL, and Code is STRING. State what is passed to Load, what Score returns, and how Code is passed to Clean. [3]



2.2 In the chart below, Count is INTEGER, Rate and Total are REAL, and Code is STRING. Write the complete pseudocode headers for Load, Score and Clean. [3]



2.3 Explain what the diamond and the curved arrow mean in this chart. Name the affected modules and give their order where relevant. [3]



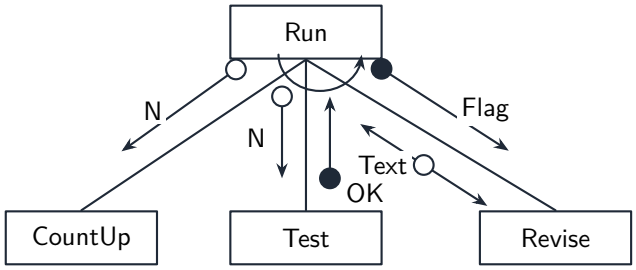
2.4 Main calls ReadValue then Calculate once each. Draw a structure chart from the headers below, including all parameters and the return value. Name the returned value Result. [4]

```
PROCEDURE ReadValue(BYREF Value : INTEGER)
FUNCTION Calculate(Value : INTEGER) RETURNS REAL
```

3 Exam-style questions

3.1 In the chart, N is INTEGER, Text is STRING and Flag is BOOLEAN.

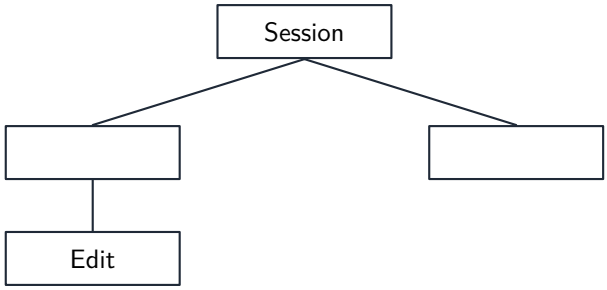
(a) Write the complete pseudocode headers for CountUp, Test and Revise. [4]



(b) Explain the curved arrow in the context of this program. [2]

3.2 Session calls either Lookup or SetFlag, decided at run time. Lookup calls Edit once. Complete the chart using the headers below. Label Lookup's return value Index. You may redraw the chart in the space below. [5]

```
FUNCTION Lookup(Key : STRING) RETURNS INTEGER
PROCEDURE SetFlag(Enabled : BOOLEAN)
PROCEDURE Edit(BYREF Name : STRING)
```



3.3 Draw a complete structure chart from these program notes. Choose suitable names for the two return values. [6]

- Manage calls either Amend or Find, chosen at run time.
- Amend takes a STRING parameter Label passed by reference.
- Find takes a STRING parameter Search and returns an INTEGER.
- Amend repeatedly calls Write followed by Ready.
- Write takes a STRING parameter Label; Ready has no parameters and returns a BOOLEAN.