THE AUSTRALIAN NATIONAL UNIVERSITY

First Semester Examinations 2006

COMP1200
(Perspectives on Computing)

Writing Period: 3 hours duration
Study Period: 15 minutes duration
Maximum Marks: 100
Permitted Materials: None
Answer all questions.

Name

Student Number

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

- This paper will be marked out of 100 and consists of 8 questions. Questions are of unequal value. The value of each question is shown within square brackets. Questions that are partitioned into parts show the number of marks given to each part within square brackets. Students should attempt all questions.
- Answer *all* questions using either a **black** or **blue** pen. Use the space provided. Marks may be lost for giving information that is irrelevant.
- There is additional space at the end of the booklet in case the space provided is insufficient. If you do need to use this extension space, clearly indicate in the first part of your answer that the answer is continued at the end.
- Students are permitted to have pens, pencils, rulers, and erasers. However, no other materials are permitted.
- Students are asked to check that this examination paper contains all 18 pages.
- This examination paper is **CONFIDENTIAL** and is not to be taken from the examination room. No pages are to be torn from this examination paper.

Official use only:

1	2	3	4	5	6	7	8	Total

Computer Architecture

QUESTION 1. Write whether each of the following statements is *True* or *False*.

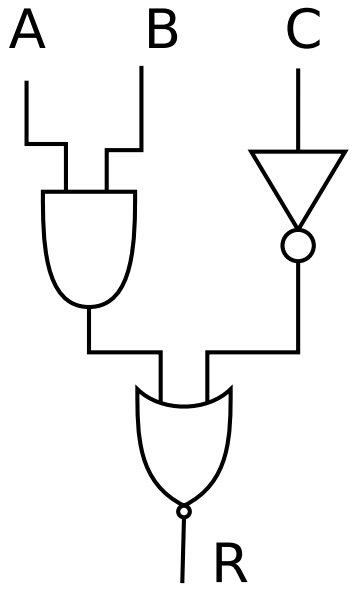
a) [1] In the layered view of a computer system, assembly language appears above machine code.
Write *True* or *False* _____

b) [1] Digital logic is the foundation for current computer hardware.
Write *True* or *False* _____

c) [1] A finite state machine has a different output for each one of its states.
Write *True* or *False* _____

[Question total 3 marks]

QUESTION 2. [3] Complete the logic table for this logic circuit. [Question total 3 marks]



A	B	C	R
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

QUESTION 3. Fill in the blanks.

a) [2] The bit pattern 11011011 in 8-bit, two's complement binary represents the decimal number _____
show your working steps here

b) [2] The representation of the decimal number +65 as an 8 bit, two's complement binary number is _____
show your working steps here

c) [3] Convert the hexadecimal (base 16) value `2B` to binary: _____
and to decimal (treating the value as 8 bit, two's complement): _____

d) [2] Convert 101.101 from binary to decimal (base 10): _____
show your working steps here

e) [3] In measuring computer memory storage, `2 MBytes` is a factor of _____

larger than `4 K bits`.

d) [5] Briefly describe each step in the cycle of actions in the *instruction cycle* (also known as the *machine cycle*). Include each of the relevant machine registers and other important components of the computer that are used in this cycle.

[Question total 17 marks]

QUESTION 4. [19 marks] Operating Systems and Networks

a) [3] Fill in the blanks:

- The basic unit that an operating system manipulates is called the _____

- The basic storage allocation unit for a filesystem is called the _____

- The architecture of a computer that uses a single storage structure for both instructions and data is called by a name derived from a person's name: the _____ computer.

b) [4] In the simple description of an operating system, a process has 5 (five) different states. Name these states:

a) _____ .

b) _____ .

c) _____ .

d) _____ .

e) _____ .

Using a diagram, describe the paths of transitions between these states.

c) [5] Briefly explain how multi-tasking can make it appear that a computer is doing more than one thing at the one time, and why this is useful to human users.

d) [3] Briefly explain how the HTTP protocol uses the TCP and IP protocols.

e) [4] Fill in the blanks:

- HTTP means _____
- URL means _____ .
- The *domain* part of the URL
  `http://cs.anu.edu.au/student/comp1200/index.html#messages`

  is _____ .
- HTML means _____ .

[Question total 19 marks]

QUESTION 5. [20 marks] Computation

a) [2] Write whether each of the following statements is *True* or *False*.

- Some algorithms with running time $O(n^2)$ are intractable.
  Write *True* or *False* _____
- The time complexity and space complexity of an algorithm are normally characterised in terms of the problem's *input* size.
  Write *True* or *False* _____

b) [3] Name the three main stages of the compilation process, in order:

(1) _____ (2) _____ (3) _____

c) [2] State what is the output of the 3rd (third) stage of compilation

_____

d) [3] Give the names of 3 (three) kinds of compression that can be applied to raster image files

- _____
- _____
- _____

e) [5] List 3 (three) characteristics of typical raster image files that make it desirable to compress them, and also make the compression methods in question (d) work very effectively.
Explain your answer briefly.

- _____
- _____
- _____

Explanation:

f) [5] Computer technology continues to make processors faster and memory sizes larger. Explain why it is still important to choose between algorithms based on their runtime and space complexity (or efficiency). Consider the example of a large library catalogue of a million entries stored on disk files–approximately 2^{20} entries–and compare the performance of two search algorithms of runtime $O(\log n)$ and $O(n)$.

[Question total 20 marks]

Question 6. [14 Marks] The History of Computing

Note: A list of significant dates taken from the course web-notes is included at the end of the question paper.

a) [5] Write whether each of the following statements is *True* or *False*.

- A change in computer hardware technology is what marks the end of one generation and the start of another in every case. Write *True* or *False* _____

- The dates for the start of the generations of software languages are the same as the dates for the start of the corresponding generations of hardware (with the same generation number). Write *True* or *False* _____
- Herman Hollerith's name was given to punched data cards used in 3rd generation computers because he used Jacquard-style punched cards for the data in the US census of 1890. Write *True* or *False* _____
- The second generation of computers used individual transistor components. . Write *True* or *False* _____
- COBOL is a second generation programming language. . Write *True* or *False* _____ .

b) [4] Briefly explain why the concept of the stored program computer is an important milestone in the history of computing.

c) [5] Edsger Dijkstra said that "computing is no more about the study of computers than astronomy is about telescopes". The scope of topics in this course, and its textbook, give a modern view of the subject that we call "computing" or "computer science". Do you agree with Dijkstra's comment today? Justify your answer.

[Question total 14 marks]

QUESTION 7. [15 Marks] Software Engineering

a) [3] Is the spiral method of software development an example of the waterfall model, or is it an example of an incremental method? Briefly explain your answer.

b) [5] Briefly explain how the analysis, design and test methods of software engineering can help to prevent software project disasters.

c) [2] Put the four development stages of the waterfall model into their normal order by writing the numbers 1 to 4 against them.

☐ implementation

☐ analysis

☐ testing

☐ design

d) [5] Briefly describe and contrast what is done in the *analysis* phase and the *design* phase in the waterfall process of development.

[Question total 15 marks]

QUESTION 8. [9 Marks] Information Technologies and Artificial Intelligence

a) [1] (fill in the blank:)

The _____ attempts to answer the question "can you make a computer program that is intellectually indistinguishable from a human person?".

b) [4] Explain what is a search tree, and how it is used to find the solution to a problem.

c) [4] Briefly explain what are the benefits of using heuristics in constructing a search tree.

[Question total 9 marks]

Additional answers to question number: ___.

Additional answers to question number: ___.

Additional answers to question number: ___.

A brief list of dates for Perspectives on Computing

1935	IBM 601 punched card machine using relays (USA)
1937	Harvard Mark I IBM ASCC: 72 x 23 decimal digit number storage: multiply time 6 seconds
1938	Konrad Zuse: electro-mechanical computer Z1 (DE)
1939	Atanasoff and Berry: special purpose electronic computer (USA)
1941	Atanasoff and Berry: linear equation solver (USA)
1941	Konrad Zuse: Z3 programmable computer (Germany): telephone relays with mechanical storage for 64 numbers
1943	Harvard Mark I programmable computer (USA)
1943	Thomas Flowers: Colossus - the first electronic computer (UK)- 2000 vacuum tubes
1946	ENIAC fully electronic computer (USA) Eckert and Mauchly: 20 x 10-digit accumulators; 5000 operations per second
1946	Konrad Zuse's programming language Plankalkül
1946	von Neumann's paper on computer architecture: "the Von Neumann computer"
1946	Grace Hopper logs the first computer "bug" (a term previously used widely in engineering)
1947	transistor invented (Bell Labs USA)
1948	First stored-program computer (UK)
1949	CSIRAC: the first Australian-designed and built computer
1949	First use of magnetic tape (USA)
1950	Floppy disk invented (Japan)
1951	First commercially available computer (USA)
1951	symbolic assembler language invented (Grace Hopper) to improve on programming by numeric codes
1951-55	IBM 701 (scientific) and IBM 702 (commercial): 50 of each were sold
1953	Magnetic core memory
1956	television introduced in Australia
1957	(approx)languages FORTRAN(1954-7); Algol (1958-60); COBOL (1959-61); LISP (1956-59)
1958	FORTRAN II revision of FORTRAN language
1959	ATLAS computer designed - virtual memory invented
1959	(approx) Move from valves to transistors; Batch Operating Systems (one program at a time)
1960	COBOL common business language - commercial programming language specification
1960	(approx) portable handheld battery powered transistor radios become common
1963	FORTRAN IV revision of FORTRAN scientific calculation programming language
1964	(approx) Move from individual transistors to integrated circuits, Multiprogramming Operating System, more than 32k words of fast memory, faster than 1 microsecond (1MHz)
1964	Gordon Moore observes IC chip densities doubling regularly
1964	IBM System/360 - mainframe computer of choice - 18 000 units sold up to 1972
1964	BASIC programming language system developed at Dartmouth College
1965	revised COBOL 65 (became ANSI standard COBOL in 1968)
1966	FORTRAN 66 (FORTRAN IV) ANSI standard - widely implemented version of scientific calculation programming language
1968	NATO Software Conference identifies "the software crisis"
1969	ARPANET network started (USA) - start of the Internet
1970	RAM chips appear - fast cheap mass production memory
1970	(approx) pocket calculator drives out slide rule for personal scientific calculations
1971	First microprocessor appears (4004); Altair 8080 microcomputer

1971 IBM System/370 - mainframe - total of 80 000 units sold up to 1988
1971 PROLOG - programming in logic language with strong mathematical foundations
1972 e-mail invented
1972 (approx) minicomputers - 12 or 16 bit computers - mainly scientific; cheaper than peripherals: DEC PDP-8
1972 Pascal programming language: portable initially for education
1972 C programming language - structured language suited for low-level portable systems programming of minicomputers
1973 First mass-market computer game (Pong)
1974 Personal computers appear: Altair hobbyists' personal micro-computer
1974 Microsoft founded - to sell BASIC standalone programming system for Altair
1974 COBOL 1974 revision of commercial programming language
1975 UNIX operating system marketed; C language starts to become popular
1975 (approx) XEROX invents Graphical User Interface (GUI)
1977 FORTRAN 77 revision with structured programming features
1977 software error in navigation controls of F-16 aeroplane: flips upside down when crosses equator (simulator)
1979 PET & TRS-80 user-friendly micro computers: 8 bit systems; CP/M operating system common
1979 VisiCalc - first computer spreadsheet program - for Apple II

1981 IBM PC released - 16 bit personal computer for desktops; command line operating system MS-DOS word processing becomes software application for PC rather than dedicated system
1981 (approx) DEC VAX-11 32 bit extended minicomputers as small mainframes
1981 the bug heard 'round the world - first Space Shuttle launch delayed 2 days by software bug
1983 Lotus 1-2-3 spreadsheet for 16 bit personal computers becomes popular application
1984 Apple Macintosh released: popular introduction of Graphical User Interface
1985 Windows GUI introduced for IBM PC
1985 FTP (file transfer protocol) specification published; widely implemented and used
1987 first widespread computer viruses and worms spread to thousands of computer systems
1988 programming design errors discovered in THERAC-25 therapeutic radiation machine: kills 3 people
1989 World Wide Web invented
1990 FORTRAN 90 revision of scientific programming language; with vector and parallel programming features
1991 (approx) Java programming language introduced - object oriented; network aware
1994 errors discovered after widespread release in Pentium processor chip
1995 WWW traffic overtakes FTP traffic on the Internet
1997 Deep Blue chess computer beats world champion Gary Kasparov at chess
1999 widespread fear of Y2K bug triggers millions of dollars of work to fix legacy systems
2000 First 1 GHz microprocessors
2000 worldwide annual PC sales reach 133 Million (all types)

Exam total marks 100