

LEVEL 5 ASSESSMENT SPECIFICATION

Student name:		Student ID number:	
Programme:	HND/BSc/MComp Computer Games Development; Web Dev; Software Engineering		
Module:	Advanced Software Development		
Module code:	ACCA5011	Contribution to Overall Module Assessment (%):	50%
Lecturer:	Gordon Dickers	Internal Verifier:	Tim Bashford
Assignment Title:	Resit:	Word count (or equivalent):	
Submission deadline:	June 12 th 2020	Return date of provisional marks & written feedback:	29th July 2020
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Critically evaluate the suitability of selected algorithms and data structures to solve given problems.

TASK DESCRIPTION

Submit a written report that covers all the tasks/questions below. Do not forget to include references and a bibliography in your report. Avoid overuse of online references.

1. Look at the 3 example functions in appendix A. They are aFunc1(), aFunc2() and aFunc3(). Analyse these functions in the context of the calling program, main() and state their time complexity using big O notation. In each case explain the reasoning behind your choice.

Weighting 20

2. The following table records the execution time of 3 C++ functions, First(), Second() and Third(). Each of these functions has been timed (in milliseconds) when processing a range of data arrays containing data of size 1000 data elements, 2000 data elements, 4000 data elements, 8000 data elements and 12,000 data elements.

	Data size in array elements				
	1000	2000	4000	8000	12,000
First()	20.05ms	80.1ms	320.3ms	1290.0ms	2700ms
Second()	10.0ms	19.8ms	41.0ms	83.0ms	12.0ms
Third()	120.1ms	120.2ms	119.5ms	122.1ms	121.1ms

Table 1

For each function, produce a graph showing the relationship between time and data size. From this graph, or from table 1 above, estimate the time complexity of each function using big O notation. Explain your answer.

Weighting 15

3. Using the binary tree of Figure 1 below, perform a pre-order traversal of the tree. Write down the data read in the order in which the nodes are visited (ensure you indicate which is the first node visited in your answer). Repeat this process using a post-order and in-order traversal.

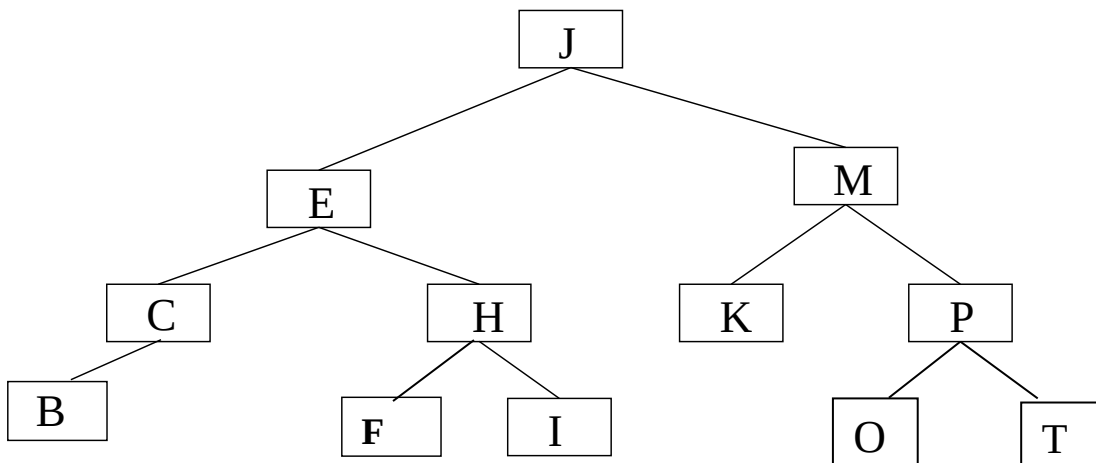


Figure 1

Weighting 15

4. Insert the letter L into the binary search tree in figure 1 above. Describe the procedure, showing the choices made at each stage of the traversal. Analyse this operation and hence state the best and worst case running times using Big-O notation, showing with examples how these situations can occur.

Weighting 10

5. Explain how the letter E is deleted from the search tree shown in figure 1 above and hence redraw the resulting tree.

Weighting 10

6. Describe how a stack data structure and while loop can be used to implement a Depth First Search algorithm. Apply your algorithm to the graph of figure 2, showing the contents of the stack after each iteration of the loop. List the node contents in the order that the nodes were visited stating any assumptions you made.

Weighting 15

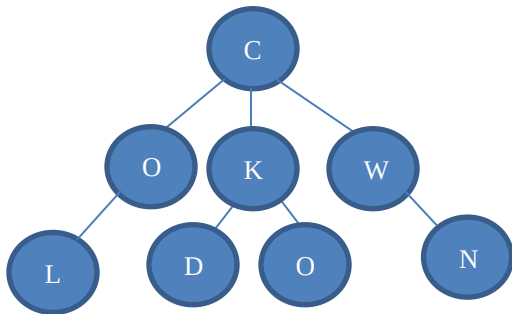


Figure 2

Provide an analysis of this algorithm including a discussion of its running time, memory usage and limitations (if any).

Weighting 15

APPENDIX A

```
//Test program for use with Task 1
//SOAC, WISA UWTSD
//Tutor: G Dickers

// define sizes of arrays
#define SIZE1 5000
#define SIZE2 10000
#define SIZE3 15000
#define SIZE4 20000
#define SIZE5 40000

//declare arrays
int testArray1[SIZE1];
int testArray2[SIZE2];
int testArray3[SIZE3];
int testArray4[SIZE4];
int testArray5[SIZE5];

//prototype functions. Functions to test
void aFunc1(int*, int);
void aFunc2(int*, int);
void aFunc3(int*, int);
void initArrays(void); //this function initialises arrays to zeros

int main(void)
//Test harness
{
    initArrays(void); //this function initialises arrays to zeros
    //Test each function with 5 arrays of differing size:
    aFunc1(testArray1, SIZE1);
    aFunc2(testArray1, SIZE1);
    aFunc3(testArray1, SIZE1);

    aFunc1(testArray2, SIZE2);
    aFunc2(testArray2, SIZE2);
    aFunc3(testArray2, SIZE2);

    aFunc1(testArray3, SIZE3);
    aFunc2(testArray3, SIZE3);
    aFunc3(testArray3, SIZE3);

    aFunc1(testArray4, SIZE4);
    aFunc2(testArray4, SIZE4);
    aFunc3(testArray4, SIZE4);

    aFunc1(testArray5, SIZE5);
    aFunc2(testArray5, SIZE5);
    aFunc3(testArray5, SIZE5);
    return 0;
}

void initArrays(void)
{
    //Initialize all arrays' contents to zero
    for (int j = 0; j < SIZE1; j++)
        testArray1[j] = 0;
    for (int j = 0; j < SIZE2; j++)
        testArray2[j] = 0;
    for (int j = 0; j < SIZE3; j++)
        testArray3[j] = 0;
    for (int j = 0; j < SIZE4; j++)
        testArray4[j] = 0;
    for (int j = 0; j < SIZE5; j++)
        testArray5[j] = 0;
}
```

```

void aFunc1(int* a, int n)
//for use with task 1
{
    int b, c, d, e, f;
    for (int i = 0; i < n; i++)
    {
        for (int k = 0; k < n; k++)
        {

            a[i] = (i + 2) % n;
            for (int j = 0; j < 10; j++)
                b = c = d = e = f = j;

        }
    }
}

void aFunc2(int* a, int n)
//for use with task 1
{
    int b, c, d, e, f;
    for (int i = 0; i < n; i++)
    {
        a[i] = (i + 2) % n;
        for (int j = 0; j < 1000; j++)
            b = c = d = e = f = j;
    }
}

void aFunc3(int* a, int n)
//for use with task 1
{
    for (int j=0;j<SIZE1;j++)
        for (int i = 0; i<SIZE1; i++)
            a[i] = a[i] + i+j;
}

```

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

Guidance specific to this assessment:

See instructions and guidance at the beginning of this document.

Notes:

- This is an individual assignment and each student's work must be a result of his/her own efforts. Collusion is considered an assessment offence.
- All work must be the student's own. A statement to this effect must be included in the submitted work.
- Any copying is considered an assessment offence and will be treated as such.
- All assessment offences will be reported to the Examination Board for further action. (as per the University's procedures)
- All references used must be identified.
- Submit a written report that covers all required tasks. Use the Turnitin link on your Moodle pages.

NOTE: The guidance offered below is linked to the five generic assessment criteria overleaf.

1. Engagement with Literature Skills

Your work must be informed and supported by scholarly material that is *relevant* to and *focused* on the task(s) set. You should provide evidence that you have accessed an appropriate *range* of sources, which may be academic, governmental and industrial; these sources may include academic journal articles, textbooks, current news articles, organisational documents, and websites. You should consider the *credibility* of your sources; academic journals are normally highly credible sources while websites require careful consideration/selection and should be used sparingly. Any sources you use should be current and up-to-date, mostly published within the last five years or so, though seminal/important works in the field may be older. You must provide *evidence* of your research/own reading throughout your work, using a suitable referencing system, including in-text citations in the main body of your work and a reference list at the end of your work.

2. Knowledge and Understanding Skills

At level 5, you should be able to demonstrate: sound knowledge and critical understanding of the well-established concepts and principles of the subject area and the way in which those principles have developed; knowledge of the main methods of enquiry in the discipline. *Knowledge* relates to the facts, information and skills you have acquired through your learning. You demonstrate your *understanding* by interpreting the meaning of the facts and information (knowledge). This means that you need to select and include in your work the concepts, techniques, models, theories, etc. appropriate to the task(s) set. You should be able to explain the theories, concepts, etc. meaningfully to show your understanding. Your mark/grade will also depend upon the *extent* to which you demonstrate your knowledge and understanding.

3. Cognitive and Intellectual Skills

You should be able to critically analyse information, and propose solutions to problems arising from that analysis, including the critical evaluation of the appropriateness of different approaches to solving problems. Your work must contain evidence of logical, analytical thinking, evaluation and synthesis. For example, to examine and break information down into parts, make inferences, compile, compare and contrast information. This means not just describing what! But also justifying: Why? How? When? Who? Where? At what cost? At all times, you must provide justification/evidence for your arguments and judgements. Evidence that you have reflected upon the ideas of others within the subject area is crucial to you providing a reasoned and informed debate within your work. Furthermore, you should provide evidence that you are able to make sound judgements and convincing arguments using data and concepts, with an understanding of the limits of knowledge, and how this influences analyses and interpretations. Sound, valid conclusions are necessary and must be derived from the content of your work. Where relevant, alternative solutions and recommendations may be proposed.

4. Practical Skills

At level 5, you should be able to use/deploy a range of established techniques within the discipline, and apply underlying concepts and principles outside the context in which they were first studied, including, where appropriate, the application of those principles in an employment context. You should be able to demonstrate how the subject-related concepts and ideas relate to real world situations and/or a particular context. How do they work in practice? You will deploy models, methods, techniques, and/or theories, in that context, to assess current situations, perhaps to formulate plans or solutions to solve problems, or to create artefacts, some of which may be creative. This is likely to involve, for instance, the use of real world artefacts, examples and cases, the application of a model within an organisation and/or benchmarking one theory or organisation against others based on stated criteria. You should show awareness of the limitations of concepts and theories when applied in particular contexts.

5. Transferable Skills for Life and Professional Practice

Your work must provide evidence of the qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and decision-making. This includes demonstrating: professional development to advance existing skills and acquire new competences that will enable you to assume significant responsibility within organisations; that you can initiate and complete tasks and procedures, whether individually and/or collaboratively; that you can use appropriate media to effectively communicate information, arguments and analysis in a variety of forms to specialist and non-specialist audiences; fluency of expression; clarity and effectiveness in presentation and organisation. Work should be coherent and well-structured in presentation and organisation.

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
	See each task for marks available	
2. Knowledge and Understanding Skills		
	See each task for marks available	
3. Cognitive and Intellectual Skills		
	See each task for marks available	
4. Practical Application Skills		
	See each task for marks available	
5. Transferable Skills for Life and Professional Practice		
	See each task for marks available	

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

GENERIC ASSESSMENT CRITERIA

Level 5

In accordance with the Framework for Higher Education Qualifications, at the end of Level 5 students will be expected to have developed sound knowledge and critical understanding of the well-established concepts and principles in their field of study, and of the way in which those principles have developed. They will have learned to apply those concepts and principles more widely outside the context in which they were first studied, including, where appropriate, the application of those principles in an employment context. They will have knowledge of the main methods of enquiry in the subject area, and ability to evaluate critically different approaches to problem solving. They will possess an understanding of the limits of their knowledge, and how this influences their analyses and interpretations. They will be able to use a range of established techniques to initiate and undertake critical analysis of information, and to propose solutions to problems arising from that analysis. They will be able to effectively communicate information, arguments and analysis in a variety of forms to specialist and non-specialist audiences, and deploy key techniques of the discipline effectively. They will be able to undertake further training, develop existing skills and acquire new competences that will enable them to assume significant responsibility within organisations. They will have the qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and decision-making.

Level 5	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
Engagement with literature (including reading, referencing, academic conventions and academic honesty)	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.	Engagement with a limited range of mostly relevant and credible sources. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts. Referencing may show minor inaccuracies or inconsistencies.	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing, with no/very few inaccuracies or inconsistencies.	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	Exceptional engagement with an extensive range of relevant and credible literature. High-level referencing skills consistently applied.
Knowledge and understanding (Sound knowledge and critical)	Major gaps in knowledge with unsatisfactory, uncritical understanding of the subject	Fragmentary knowledge, with only superficial critical understanding. Some significant	Limited but adequate knowledge and critical understanding of the well-	Knowledge is reasonably detailed and accurate. A good critical understanding of	Knowledge is reasonably extensive. Exhibits very competent critical	Excellent, detailed knowledge and highly critical understanding of the well-	Exceptionally detailed knowledge and outstanding critical understanding of

Level 5	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
understanding of the well-established concepts and principles in their field of study; knowledge of the main methods of enquiry in the discipline.)	matter. Much irrelevant material. Substantial inaccuracies. Significantly flawed understanding of the main methods of enquiry in the discipline.	inaccuracies and/or irrelevant material. Incomplete or partially flawed understanding of the main methods of enquiry in the discipline.	established concepts and principles within the subject area, with a few gaps in the selection of material. A narrow critical understanding of the main methods of enquiry.	the well-established concepts and principles and the main methods of enquiry, with minor gaps in the selection of material.	understanding of the well-established concepts and principles of the subject and the main methods of enquiry. Breadth and depth of knowledge.	established concepts and principles of the subject and the main methods of enquiry.	the well-established concepts and principles of the subject and the main methods of enquiry. May go beyond established theories.
Cognitive and intellectual skills (Critical evaluation and analysis of concepts and principles; argument and judgement; the limits of their knowledge, and how this influences their analyses and interpretations.)	Wholly or almost wholly descriptive work. Little or no critical evaluation and analysis of concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Unsubstantiated generalisations or opinion, made without use of any credible evidence.	Largely descriptive work, with superficial use of critical evaluation and analysis of concepts and principles. Weak development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.	Limited attempt at critical evaluation and analysis of concepts and principles, tending towards description. Some evidence to support arguments and judgements but these may be underdeveloped, with a little inconsistency / mis-interpretation or failure to fully recognise limits of knowledge.	Some critical evaluation and analysis of concepts and principles, though descriptive in parts. An emerging awareness the limits of their knowledge and ability to use evidence to support the argument though with some tendency to assert/state opinion rather than argue on the basis of reason and evidence. Mostly valid arguments and logical judgements.	Sound critical evaluation and analysis of concepts. Is selective in the range of evidence used and synthesises rather than describes. Ability to devise arguments that show awareness of different stances, and use evidence convincingly, to support appropriate and valid judgements.	Excellent critical evaluation and analysis of concepts and principles leading to logical, evidence-based, reasoned arguments and judgements. Explicit recognition of other stances and a strong awareness of the limits of their knowledge. A capacity for independent thought and ability to 'see beyond the question', suggesting some grasp of the broader field and wider concepts.	Outstanding critical evaluation and analysis of concepts and principles. Uses evidence exceptionally well to connect ideas, and support highly logical and persuasive, arguments and judgements. Evidence of independent thought and ability to 'see beyond the question', suggesting a clear grasp of the broader field and wider concepts. Perceptive recognition of the limits of their

Level 5	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
							knowledge, and how this influences their analyses and interpretations.
Practical skills (Apply underlying concepts and principles more widely outside the context in which they were first studied; use a range of established techniques; propose solutions to problems arising from analysis.)	Limited or no use of established methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Limited understanding of the application of theory to practice or making appropriate links between the two. Very weak problem-solving skills outside the context in which they were first studied.	Rudimentary application of established methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak understanding of the application of theory to practice, with only occasional evidence of making appropriate links between the two. Weak problem-solving skills outside the context in which they were first studied.	An adequate awareness and mostly appropriate application of established methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Theoretical knowledge and understanding applied in practice, but not always making logical links between the two. Can identify problems and propose basic solutions outside the context in which they were first studied.	A good and appropriate application of established methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Mainly consistent, accurate and logical application of theory to practice, making appropriate links between the two. Can identify problems and propose mostly appropriate solutions outside the context in which they were first studied.	A very good application of a range of established methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive insights. Consistent, accurate and logical application of theory to practice, making appropriate links between the two. Can identify problems and propose appropriate solutions outside the context in which they were first studied. Evidence of some creativity.	An advanced application of a range of established methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Consistent, accurate and logical application of theory to practice, making well-developed links between the two. Can identify problems and propose excellent, creative solutions outside the context in which they were first studied.	Exceptional levels of application and deployment skills using established methods, materials, tools and/or techniques. Consistent, accurate and logical application of theory to practice, making highly developed links between the two. Can identify routine and non-routine problems and propose quite sophisticated, creative solutions outside the context in which they were first studied.
Transferable skills for life and	Communication medium is	Communication medium is poorly designed and/or	Can communicate in a suitable	Can communicate effectively in a	Can communicate well, confidently	Can communicate professionally	Can communicate with an

Level 5	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
professional practice (Effectively communicate in a variety of forms to specialist and non-specialist audiences; the qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and decision-making.)	inappropriate or misapplied. Work is poorly structured, disorganised and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively as part of a group. Little or no evidence of the skills for employment requiring the exercise of personal responsibility and decision-making.	not suitable for the audience. Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of personal responsibility and decision-making.	medium for the audience but with some room for improvement. Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of personal responsibility and decision-making, with some areas of minor weakness.	suitable medium for the audience, but may have minor errors. Mostly coherent, organised work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of personal responsibility and decision-making, with some areas of strength and some of minor weakness.	and consistently in a suitable medium for the audience. Work is coherent, fluent, well-structured and organised. Can work very well autonomously and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of personal responsibility and decision-making, with just occasional minor weakness.	confidently and consistently in a suitable medium for the audience. Work is coherent, very fluent and is presented proficiently. Can work autonomously with initiative. Where relevant can work professionally within a team, showing leadership skills as appropriate, and meeting obligations. Demonstrates excellent skills for employment requiring the exercise of personal responsibility and decision-making and an appetite for further development.	exceptionally high level of professionalism, highly suitable for the audience. Work is exceptionally coherent, very fluent and is presented professionally. Can work exceptionally well within a team, showing leadership skills. Demonstrates exceptional skills for employment requiring the exercise of personal responsibility and decision-making and an appetite for further development.

THIS DOCUMENT IS ALSO AVAILABLE IN WELSH