

Student Name: _____ Student ID # _____

OU Academic Integrity Pledge

On my honor I affirm that I have neither given nor received inappropriate aid in the completion of this exercise.

Signature: _____ Date: _____

Notes Regarding this Examination

Open Book(s) You may consult any printed textbooks in your immediate possession during the course of this examination.

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No Electronic Devices Permitted You may not use any electronic devices during the course of this examination, including but not limited to calculators, computers, and cellular phones. All electronic devices in the student's possession must be turned off and placed out of sight (for example, in the student's own pocket or backpack) for the duration of the examination.

Violations Copying another's work, or possession of electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies.

Part I. Recursion

1. (2 points) For recursion to terminate, which of the following are required?
 - A. A basis case
 - B. A recursive case that progresses toward a basis case
 - C. An outer method to store data structures being constructed
 - D. A and B
 - E. A, B, and C
2. (2 points) Which type of code typically is most space efficient?
 - A. Tail recursive
 - B. Self recursive
 - C. Mutually recursive
 - D. Iterative
 - E. A, B, and C
3. (2 points) Which type of code typically is most time efficient?
 - A. Tail recursive
 - B. Self recursive
 - C. Mutually recursive
 - D. Iterative
 - E. A, B, and C
4. (2 points) Which type of code is least likely to cause a stack overflow?
 - A. Tail recursive
 - B. Self recursive
 - C. Mutually recursive
 - D. Iterative
 - E. A, B, and C
5. (2 points) Optimizing compilers can often convert which type of code to iterative code?
 - A. Tail recursive
 - B. Self recursive
 - C. Mutually recursive
 - D. A and B
 - E. A, B, and C
6. (2 points) Complex recursive methods can always be converted to iterative methods using which data structure?
 - A. Linked lists
 - B. Arrays
 - C. Stacks
 - D. Queues
 - E. Hash tables
7. (2 points) A call stack operates in which way?
 - A. First in-first out (FIFO)
 - B. First in-last out (FILO)
 - C. First in-delayed out (FIDO)
 - D. First out-first in (FOFI)
 - E. First out-last out (FOLO)

Exam continues in Part II.

Part II. Application of Recursion and Pre- and Postconditions

Consider the following code:

```
public class Powers {
    private static int powers(int p, int n) {
        if (n == 0) {
            System.out.println(p + "^" + n + "=" + 1);
            return 1;
        }
        else {
            int result = p * powers(p, n - 1);
            System.out.println(p + "^" + n + "=" + result);
            return result;
        }
    }
    public static void main(String[] args) {
        System.out.println(powers(2, 10));
    }
}
```

8. (2 points) What type of code is `powers`?
 - A. Tail recursive
 - B. Recursive
 - C. Iterative
 - D. A and B
 - E. A, B, and C
9. (2 points) Which is the basis case for `powers`?
 - A. `if (n == 0) { ... }`
 - B. `else { ... }`
 - C. `private static int powers (int p, int n) { ... }`
 - D. `public void main (String[] args) { ... }`
 - E. The basis case for `powers` is implicit
10. (2 points) Which is the recursive call for `powers`?
 - A. `System.out.println(p + "^" + n + "=" + 1);`
 - B. `powers(p, n - 1);`
 - C. `System.out.println(p + "^" + n + "=" + result);`
 - D. `powers (2, 10);`
 - E. This code has no recursive case
11. (2 points) What is the first value returned by `powers`?
 - A. 0
 - B. 1
 - C. 2
 - D. 10
 - E. 1024
12. (2 points) What is the first line printed by this program?
 - A. $2^0=1$
 - B. $2^1=2$
 - C. $2^{10}=1024$
 - D. 1024
 - E. Nothing is printed; the program will recurse until the call stack overflows

13. (2 points) What is the last value returned by `powers`?
- A. 0
 - B. 1
 - C. 2
 - D. 10
 - E. 1024
14. (2 points) What is the last line printed by this program?
- A. $2^0=1$
 - B. $2^1=2$
 - C. $2^{10}=1024$
 - D. 1024
 - E. Nothing is printed; the program will recurse until the call stack overflows
15. (2 points) How many recursive calls are made to `powers`?
- A. 1
 - B. 2
 - C. 10
 - D. 11
 - E. 1024
16. (2 points) How many calls are made to `powers` in total?
- A. 1
 - B. 2
 - C. 10
 - D. 11
 - E. 1024
17. (2 points) How many times does `powers` return?
- A. 1
 - B. 2
 - C. 10
 - D. 11
 - E. 1024
18. (2 points) Which of the following would be a reasonable precondition for `powers` to check?
- A. (`n < 0`)
 - B. (`p < 0`)
 - C. (`result < 0`)
 - D. All of the above
 - E. None of the above
19. (2 points) Which of the following would be a reasonable postcondition for `powers` to check?
- A. (`n < 0`)
 - B. (`p < 0`)
 - C. (`result < 0`)
 - D. All of the above
 - E. None of the above

Exam continues in Part III.

Part III. Another Application of Recursion

Consider the following code:

```
public class Builder {
    private static void build(String str1, String str2){
        if (str2.length() > 0) {
            String str3 = str1 + str2.charAt(0);
            System.out.println(str3);
            build(str3, str2.substring(1));
        }
    }

    public static void main(String[] args) {
        build("", "exam");
    }
}
```

Note the following from the `String` API:

```
public String substring(int beginIndex, int endIndex)
```

Returns a new string that is a substring of this string. The substring begins at the specified `beginIndex` and extends to the character at index `endIndex - 1`. Thus the length of the substring is `endIndex-beginIndex`.

20. (2 points) What type of code is `build`?
 - A. Tail recursive
 - B. Recursive
 - C. Iterative
 - D. A and B
 - E. A, B, and C
21. (2 points) Which is the basis case for `build`?
 - A. `if (str2.length() > 0)`
 - B. `String str3 = str1 + str2.charAt(0);`
 - C. `System.out.println(str3);`
 - D. `build(str3, str2.substring(1));`
 - E. The basis case for `build` is implicit
22. (2 points) Which is the recursive call for `build`?
 - A. `if (str2.length() > 0)`
 - B. `String str3 = str1 + str2.charAt(0);`
 - C. `System.out.println(str3);`
 - D. `build(str3, str2.substring(1));`
 - E. The recursive call for `build` is implicit
23. (2 points) What is the first line printed by this program?
 - A. e
 - B. exam
 - C. m
 - D. maxe
 - E. The empty `String`

24. (2 points) What is the last line printed by this program?
- A. e
 - B. exam
 - C. m
 - D. maxe
 - E. The empty `String`
25. (2 points) How many recursive calls are made to `build`?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5
26. (2 points) How many calls are made to `build` in total?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5
27. (2 points) How many times does `build` return?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5
28. (2 points) Which of the following would be a reasonable precondition for `build` to check?
- A. `(str1.length() == 0)`
 - B. `(str1 == "")`
 - C. `(str2.length() == 0)`
 - D. `(str2 == "")`
 - E. None of the above
29. (2 points) Which of the following would be a reasonable postcondition for `build` to check?
- A. `(str1.length() == 0)`
 - B. `(str1 == "")`
 - C. `(str2.length() == 0)`
 - D. `(str2 == "")`
 - E. None of the above

Exam continues in Part IV.

Part IV. Preconditions, Postconditions, Exceptions, and Assertions

30. (2 points) Which order is correct for a set of related blocks?
- A. `catch, finally, try`
 - B. `finally, catch, try`
 - C. `try, finally, catch`
 - D. `catch, try, finally`
 - E. `try, catch, finally`
31. (2 points) Which is often nested inside a `catch` block?
- A. A `catch` block
 - B. A `finally` block
 - C. A `try` block
 - D. A `try-catch` block
 - E. A `finally-try` block
32. (2 points) The typical purpose of a precondition in a private method is which?
- A. Debugging the development team's own code
 - B. Ensuring correct use by other developers
 - C. Ensuring correct performance after deployment
 - D. All of the above
 - E. None of the above
33. (2 points) The typical purpose of a precondition in a public method is which?
- A. Debugging the development team's own code
 - B. Ensuring correct use by other developers
 - C. Ensuring correct performance after deployment
 - D. All of the above
 - E. None of the above
34. (2 points) The typical purpose of a postcondition in a private method is which?
- A. Debugging the development team's own code
 - B. Ensuring correct use by other developers
 - C. Ensuring correct performance after deployment
 - D. All of the above
 - E. None of the above
35. (2 points) The typical purpose of a postcondition in a public method is which?
- A. Debugging the development team's own code
 - B. Ensuring correct use by other developers
 - C. Ensuring correct performance after deployment
 - D. All of the above
 - E. None of the above
36. (2 points) How do assertions differ from conditionals with exceptions?
- A. Assertions are always true
 - B. Assertions can be used for preconditions
 - C. Assertions can be used for postconditions
 - D. Assertions can be turned off
 - E. Assertions don't halt the program

37. (2 points) Exceptions are which of the following?
- A. Objects that can be thrown
 - B. Objects that can be caught
 - C. Objects that can be tried
 - D. A and B
 - E. A, B, and C
38. (2 points) Why are exceptions often used with I/O?
- A. I/O relies on resources outside of the program itself
 - B. There are many different types of I/O
 - C. I/O is generally much slower than internal computations
 - D. All of the above
 - E. None of the above

Exam continues in Part V.

Part V. Ethics

Situation (hypothetical).

All of your answers in this part should be based on the scenario below.

Jolene is angry. On Friday she was told by Prof. Green that her assignment was almost identical to another student's, so both of them will get zeros on that assignment because, according to Prof. Green, there was obviously some copying involved and that violates the University's academic code. Well, Jolene didn't copy anyone, so someone must have copied her! Jolene explained that to Prof. Green but Prof. Green insisted that even though Jolene *submitted* her assignment first, Prof. Green has no way to know who actually *completed* the assignment first and who copied, so they'll both get zeros. "That is so unfair!" Jolene raged to herself.

Jolene is also determined—determined to do something. She's been stewing about this all weekend but now it's Monday, she's back at work, and she has turned her frustration into a plan of action. Since the assignment required licensed software on the University's computers and Jolene works for IT, she should be able to search through accounts for an assignment that matches hers, look at the time stamps on the files, and bingo, she'll have the evidence she needs and Prof. Green will have to give her back her points!

39. (2 points) Of the following ethical principals from the IEEE Code of Ethics, which has Jolene most likely violated in this scenario?
- A. "to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment"
 - B. "to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist"
 - C. "to reject bribery in all its forms"
 - D. "to improve the understanding of technology; its appropriate application, and potential consequences"
 - E. "to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others"
40. (2 points) Of the following ethical principals from the ACM Code of Ethics, which has Jolene most likely violated in this scenario?
- A. "Avoid harm to others"
 - B. "Contribute to society and human well-being"
 - C. "Be fair and take action not to discriminate"
 - D. "Honor property rights including copyrights and patent"
 - E. "Honor confidentiality"
41. (2 points) Of the following ethical principals from the ACM Code of Ethics, which has Jolene most likely violated in this scenario?
- A. "Acquire and maintain professional competence"
 - B. "Accept and provide appropriate professional review"
 - C. "Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks"
 - D. "Improve public understanding of computing and its consequences"
 - E. "Access computing and communication resources only when authorized to do so"

42. (2 points) Of the following ethical principals from the joint ACM/IEEE Software Engineering Code of Ethics, which has Jolene most likely violated in this scenario?
- A. "Software engineers shall act consistently with the public interest"
 - B. "Software engineers shall act in a manner that is in the best interests of their client and employer consistent with the public interest"
 - C. "Software engineers shall ensure that their products and related modifications meet the highest professional standards possible"
 - D. "Software engineers shall be fair to and supportive of their colleagues"
 - E. "Use the property of a client or employer only in ways properly authorized, and with the client's or employer's knowledge and consent"
43. (2 points) Which of the following is a likely motivation for Jolene's violation of one of the ethical principals above?
- A. Jolene is angry about getting a zero
 - B. Jolene doesn't like Prof. Green
 - C. Jolene is determined to do her job in IT
 - D. Jolene is feeling rushed for time
 - E. Jolene is embarrassed by her poor coding skills
44. (2 points) Which of the following is a likely reason for Jolene's violation of one of the ethical principals above?
- A. Jolene doesn't care about intellectual property
 - B. Jolene is focused on the wrong done to her
 - C. Jolene likes Prof. Green
 - D. Jolene doesn't read software license agreements
 - E. Jolene wants to switch majors
45. (2 points) Which entity is likely to benefit from Jolene's actions?
- A. Jolene because she'll get her points back
 - B. IT because Jolene is a determined employee
 - C. The company that licensed the software because the unauthorized user will be caught
 - D. All of the above
 - E. None of the above
46. (2 points) Which entity is likely to be harmed by Jolene's actions?
- A. Jolene because she'll get in more trouble
 - B. IT because Jolene is determined to cause problems for them
 - C. The company that licensed the software because they'll get more revenue
 - D. All of the above
 - E. None of the above
47. (2 points) Which of the following is an ethical-decision-making problem (interfering factor) that is likely to have contributed to at least one of Jolene's decisions?
- A. She failed to identify long term consequences for others
 - B. She made hasty decisions
 - C. She was unaware of her own biases
 - D. She failed to identify hidden motives or agendas of involved parties and their decisions' implications for each of these parties
 - E. She failed to evaluate how her decisions would be viewed by respected professionals (experts)

48. (2 points) Which of the following is an ethical-decision-making problem (interfering factor) that is likely to have contributed to at least one of Jolene's decisions?
- A. She was subjective and allowed strong feelings to inhibit her decision making
 - B. She broke the law by using a computing system in an unauthorized way
 - C. She violated her employee agreement with IT by searching through accounts
 - D. She allowed another student to copy her assignment
 - E. She raged at Prof. Green
49. (2 points) Which of the following is an ethical-decision-making strategy that Jolene could have employed to improve her ethical decision making?
- A. She could have only looked at data that was publicly available
 - B. She could have just accepted the zero on the assignment
 - C. She could have suggested to Prof. Green that IT could help
 - D. She could have taken her case to the Dean of her college
 - E. She could have considered how others might view her actions
50. (2 points) Which of the following is an ethical-decision-making strategy that Jolene could have employed to improve her ethical decision making?
- A. She could have remained objective and not allowed her emotions to rule her
 - B. She could have anticipated consequences for others
 - C. She could have weighed the benefits to her against the harms to her classmates
 - D. She could have asked Prof. Green for a replacement assignment
 - E. She could have dropped the course and taken it the next time it was offered

Bonus questions are in Part VI.

Part VI. BONUS QUESTIONS

Answering the following questions correctly will add the listed number of points to your Exam 3 score, which may go beyond 100.

51. (2 points) The default behavior of a `JList` includes which of the following?
- A. Clicking on an item in the list highlights it
 - B. The items displayed are updated if the backing list is updated
 - C. A scroll bar appears if and only if there is more content than can be displayed in the window
 - D. A and B
 - E. A, B, and C
52. (2 points) Which of the following is a disadvantage of `GridLayout` as compared to `BorderLayout`?
- A. `GridLayout` presents the items in the order they were added
 - B. In `GridLayout`, items must all be the same size
 - C. `GridLayout` will fail if not all of requested grid cells are filled
 - D. A and B
 - E. A, B, and C
53. (2 points) A layout manager is most likely to be created by which of the following?
- A. A Model
 - B. A View
 - C. A Controller
 - D. A Driver
 - E. None of the above
54. (2 points) Which of the following is most likely to create a timer?
- A. A Model
 - B. A View
 - C. A Controller
 - D. A Driver
 - E. None of the above
55. (2 points) Which type of polymorphism is based on two other types of polymorphism?
- A. Overloading
 - B. Overriding
 - C. Subclass assignment
 - D. Dynamic method binding
 - E. None of the above
56. (2 points) Encapsulation involves which of the following objectives?
- A. Information hiding
 - B. Access restrictions
 - C. Code compression
 - D. A and B
 - E. A, B, and C

END.