

Practice Exam

Preparatory Course Computer Science and Mathematics

Programming

1. What is the output of the following script?

```
x = 3.5
print("Hello")
if x == 0:
    print("A")
elif x > 0:
    print("B")
else:
    print("C")
print("Goodbye")
```

2. What is the output of the following script? What value does a have at the end of the script?

```
a = 1
while a <= 10:
    print(a)
    a = a + 3
```

3. Assume that x is a variable that has a floating point number as its value. Write a script that prints "x is greater than or equal to 3" if x is greater than or equal to 3 and "x is smaller than 2" if x is smaller than 2.
4. What is the output of the following script?

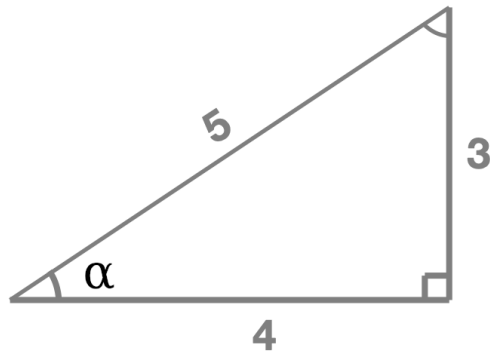
```
numbers = [2, 4, 6, 8, 10]
numbers[3] = 9
for number in numbers:
    number2 = 2*number+1
    print(number2)
```

Functions

5. Let $f(x) = 5(x + 2)^3$. Which of the following is true? Just list the letters of the true statements.
- (a) f is the result of translating the function $g(x) = 5x^3$ by -2 along the x axis
 - (b) f is the result of stretching the function $h(x) = 5(x + 2)$ by 3 along the y axis
 - (c) f is the result of translating the function $i(x) = 5x^3$ by 2 along the y axis
 - (d) f is the result of compressing the function $j(x) = (x + 2)^3$ by a factor of 5 along the x axis
 - (e) f is the result of scaling the function $k(x) = (x + 2)^3$ by a factor of 5 along the y axis

Linear Algebra

6. Calculate the angle α in the following right triangle:



Note: You can calculate the inverse sine of a number x by entering $\arcsin(x)$ into wolframalpha.com or google.com. Same for $\arccos(x)$ and $\arctan(x)$.

7. Let $\mathbf{a} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$. Calculate the angle between the two vectors using the formula $\alpha = \cos^{-1} \left(\frac{\langle \mathbf{a}, \mathbf{b} \rangle}{\|\mathbf{a}\| \|\mathbf{b}\|} \right)$.
8. Calculate $\begin{pmatrix} 4 \\ 1 \end{pmatrix} + 2 \cdot \begin{pmatrix} 2 \\ 1 \end{pmatrix}$
9. (bonus) Calculate $\begin{pmatrix} 1 & 2 \\ 0 & 3 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix}$
10. (bonus) Calculate $\begin{pmatrix} 1 & 2 & -1 \\ 1 & 2 & 1 \\ 3 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 3 \\ 0 \end{pmatrix}$

Derivatives

11. Calculate the derivative and local extremum of $f(x) = 3x^3 + x^2 + 3$
12. Calculate the derivative of $h(x) = 3e^{4x}$
13. Calculate the derivative of $j(x) = (3x^2 + 2x)x^3$ using the product rule.

Integration

14. The antiderivative of the function $f(x) = 4x^3 + 2$ is $F(x) = x^4 + 2x$. Calculate the integral $\int_2^4 f(x)$.
15. Assume that there is a function s such that $\int_0^{\frac{\pi}{2}} s(x) = -\int_{\frac{\pi}{2}}^{\pi} s(x)$. Calculate $\int_0^{\pi} s(x)$.