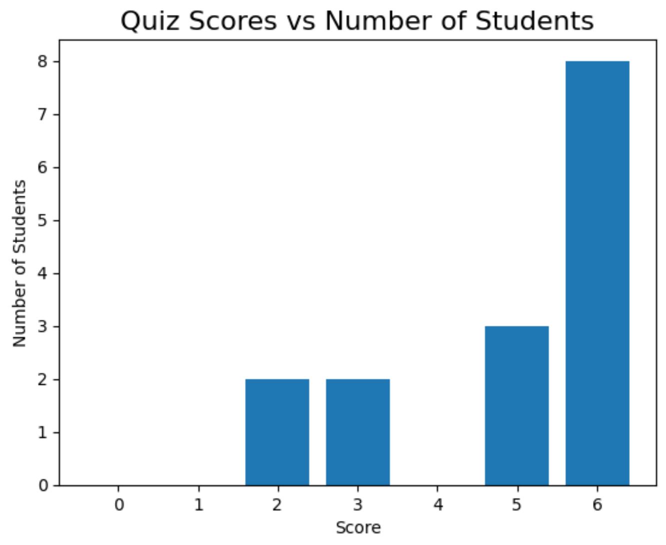
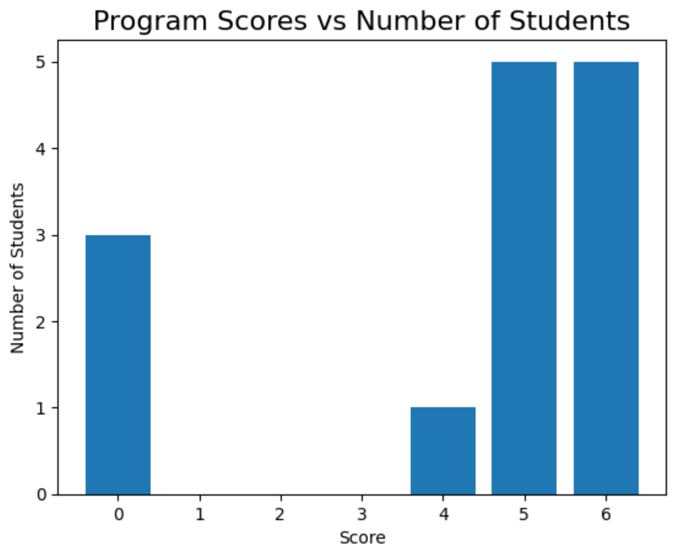
# Test 1, observations

- Great participation, nearly everyone attempted!
- Overall students did better in quiz
  - 8x full marks in quiz vs 5x full marks in programming
- 4 students received a zero in programming ( with 1 not attempted)





## Test 2 , analysis

- The quizzes
  - seem to be easier for students to master
  - Success cause everyone attempted, next we figure out how to raise scores there
    - Suggestions ?
- Programming
  - It was amazing attempt
  - The codes generally worked
  - But 4/15 students had zeroes.
  - Suggestions ?
- Goal :We need raise scores for everyone and move some in attempted stage
  - Note
    - Compete with yourself , Do better than your last attempt
    - Ask for help
      - on what you don’t know, to learn it.
      - And even on what you know , i.e. to master it

## Topics for Test 2

- Mathematical expressions
  - Representations ( infix, prefix, postfix)
  - Evaluation or expression
- Discrete Mathematics
  - Logical Operators (AND , OR , NOT, SHIFT,…)
  - Boolean logic
- Programming
  - char, string ,arrays
  - Loops
  - Conditionals
    - If/else
    - switch/case

## Infix expressions

- Encounter them in grade maths. e.g.
    - (11+14)/(9 - 3) + 2
    - 3+7 / (4 * 5 - 6)
    - - 2 + 8 / 2
- Can also be written using variables
    - (a + b) / (c – d ) + e
    - x + y  / (g * h – k)
- Evaluated using
    - PEMDAS / BODMAS

# Expression : anatomy

- Expression is made of
  - Operators ( + , - , * , /)
  - Operands (numbers, variables)
- Unary operators : - a
  - <operator> <operand>
- Binary operators (infix) : a + b
  - < operand> <operator>  <operand>

# Prefix/Postfix expressions

- Benefits
  - Remove ambiguity( i.e. can  forget PEMDAS, BODMAS)
  - Computer friendly
  - Works with both unary/binary
  - Faster evaluation
- Expression styles
  - Infix : operator in **middle** of operands
    - (5+6)*3
    - < ọřêsǻŋđ> <*operator*> <ọřêsǻŋđ>
  - Prefix : operator **before** operands
    - * + 5 6 3
    - <*operator*> <ọřêsǻŋđ> < ọřêsǻŋđ>
  - Postfix : operator **after** operands
    - 5 6 + 3 *
    - <ọřêsǻŋđ> < ọřêsǻŋđ> <*operator*>

# Evaluating expression,
## *but first **Stacks** and **Queues***

- What is a **Stack** ?
  - This is a sequential structure of **items**
  - That are **pushed at one end**
  - **Pulled** via the **same end**
  - **LIFO** : Last in First Out
  - Examples
    - Stack of plates
    - Your turned in paper assignments
- What is a **Queue**?
  - Another sequential structure of **items**
  - that are **pushed at one end**
  - **Pulled** via the **opposite end**
  - **FIFO** : First In First Out
  - Examples
    - Queue for buying tickets
    - Traffic in one way single lane

## Evaluating **prefix** expression

- Infix : (5+6)*3
  - * + 5 6 3
  - - + 2 * 3 4 / 16 ^ 2 3
- Algorithm (harder way)
  - Scan from right to left
  - Anytime you find an operator
    - Evaluate the operation using the previous 2 operands
    - Replace the <*operator*> <ộřêsắŋđ> < ộřêsắŋđ> with sêṣụľʧ in the expression
  - Repeat the steps till only 1 operand is left

# Evaluating postfix expression

- Evaluate
  - 2 3 1 * + 9 –
  - 5 3 + 6 2 / * 3 5 * +
- *Algorithm to evaluate (use **stack**)*
  1. Push the operands in a stack
  2. When you encounter a operator
     - Pop 2 operands
     - Perform the operation on operands
     - Push the result in stack
  - Repeat from 1 until expression is parsed
  - The last item in stack is the answer
     - There would be only 1 item left when done correctly
- * prefix expr can also be evaluated in this way ( *just in **reverse***)

# Evaluate

- Prefix
  - - * 5 + - 4 2 2 / 6 3
  - - * + 3 5 7 + / 4 2 1
  - - + 10 * 2 3 + 4 / 5 5
- Postfix
  - 1 2 + 3 4 + * 5 6 - / 7 +
  - 8 2 / 3 4 + * 5 1 + 2 / -
  - 9 8 4 2 1 ^ * / - 3 +

## Answers

- Prefix
  - - * 5 + - 4 2 2 / 6 3
    - Ans : **18**
  - - * + 3 5 7 + / 4 2 1
    - Ans : **53**
  - - + 10 * 2 3 + 4 / 5 5
    - Ans : **11**
- Postfix
  - 1 2 + 3 4 + * 5 6 - / 7 +
    - Ans : **-14**
  - 8 2 / 3 4 + * 5 1 + 2 / -
    - Ans : **25**
  - 9 8 4 2 1 ^ * / - 3 +
    - Ans : **11**

# Practice: Programming

- Write a function that takes a string and checks if it is a palindrome
  - Returns true if palindrome is found else false
  - Hints:  string indexing, loops, if , comparing characters
- Count the number of vowels, consonants in a sentence.
  - Vowels : a,e,i,o,u
  - Consonant : everything else other than vowels
  - Ignore : spaces (‘ ’,) comma(,) dash(-),semicolon(;),colon( : )
- Find the most frequent word in a sentence
  - If more than 1 word has same frequency return the lexicographically smaller one.

## Review Evaluating Prefix/Postfix

- From last week
  - Operator
  - Operand
  - Stack
  - Queue
- Evaluating Prefix/Postfix
  - <3 questions each>

# Precedence and associativity

- Precedence ( highest priority first)
  - ()
  - ^
  - / *
  - - +
- Associativity
  - Right to left : ^
  - Left to right : + , - , * , /
- Notes
  - () not categorized as associative, they represent grouping mechanism

## Precedence and associativity

- Example
  - 10 + 20 / 2 * 3 – 5
    - ➔ 10 +((20 / 2) * 3)-5   // added parenthesis for denoting precedence
    - ➔ 10 + (10 * 3 ) -5 // interior most precedence first
    - ➔10 + 30 - 5
    - ➔ **35**

## Precedence and associativity (lets evaluate)

- 2 + 3 * 4 ^2
- 2 ^ 3 ^ 2
- 100 / 2 * 5 ^ 2 ^ 1

## Precedence and associativity (answers)

- 2 + 3 * 4 ^2
    - ➔ 2 + 3 * 16
    - ➔ 2 + 48
    - ➔ **50**
- 2 ^ 3 ^ 2
    - ➔ 2 ^ 9 // ^ is evaluated from right to left , so 3 ^ 2 goes first
    - ➔ **512**
    - ~~Not 64~~
- 100 / 2 * 5 ^ 2 ^ 1
    - ➔ 100 / 2 * 25 // Again 2 ^ 1 goes first
    - ➔ 50 x 25
    - ➔**1250**

## Convert to Prefix/Postfix (examples)

- B * C
  - Prefix : *** B C**
  - Postfix : **B C ***
- A + B * C
  - Prefix : +**A*BC**
  - Postfix : **ABC*+**
- (5 + 6) * 3
  - Prefix : *** + 5 6 3**
  - Postfix : **5 6 + 3 ***

## Convert to Postfix

- How to convert!
  - Convert the highest precedence/priority first
  - ( do paranthesize for mental ease)
- (a + b) / (c – d ) + e
- x + y  / (g * h – k)

## Convert to Postfix

- How to convert!
  - Convert the highest priority first
  - ( and paranthesize for mental ease)
- (a + b) / (c – d ) + e
  - Prefix : **+ / + a b – c d e**
  - Postfix : **a b + c d - / e +**
- x + y  / (g * h – k)
  - Prefix : **+ x / y - * g h k**
  - Postfix : **x y g h * k - / +**

## Convert to Prefix and Postfix

- a + b - c * d + e ^ f
- (a + b) * c - (d - e) * (f + g)
- ((a + b) * (c + d) / (e - f)) + g
- a * (b + c) / (d - e)
- a - b / (c * d ^ e)
- (a + b) * (c + d) - e

# Convert to Prefix and Postfix (answers)

| Infix | Prefix | Postfix |
|---|---|---|
| a + b - c * d + e ^ f | + - + a b * c d ^ e f | a b + c d * - e f ^ + |
| (a + b) * c - (d - e) * (f + g) | - * + a b c * - d e + f g | a b + c * d e - f g + * - |
| ((a + b) * (c + d) / (e - f)) + g | + / * + a b + c d - e f g | a b + c d + * e f - / g + |
| a * (b + c) / (d - e) | / * a + b c - d e | a b c + * d e - / |
| a - b / (c * d ^ e) | - a / b * c ^ d e | a b c d e ^ * / - |
| (a + b) * (c + d) - e | - * + a b + c d e | a b + c d + * e - |