Stack and Queue

CS10001: Programming & Data Structures

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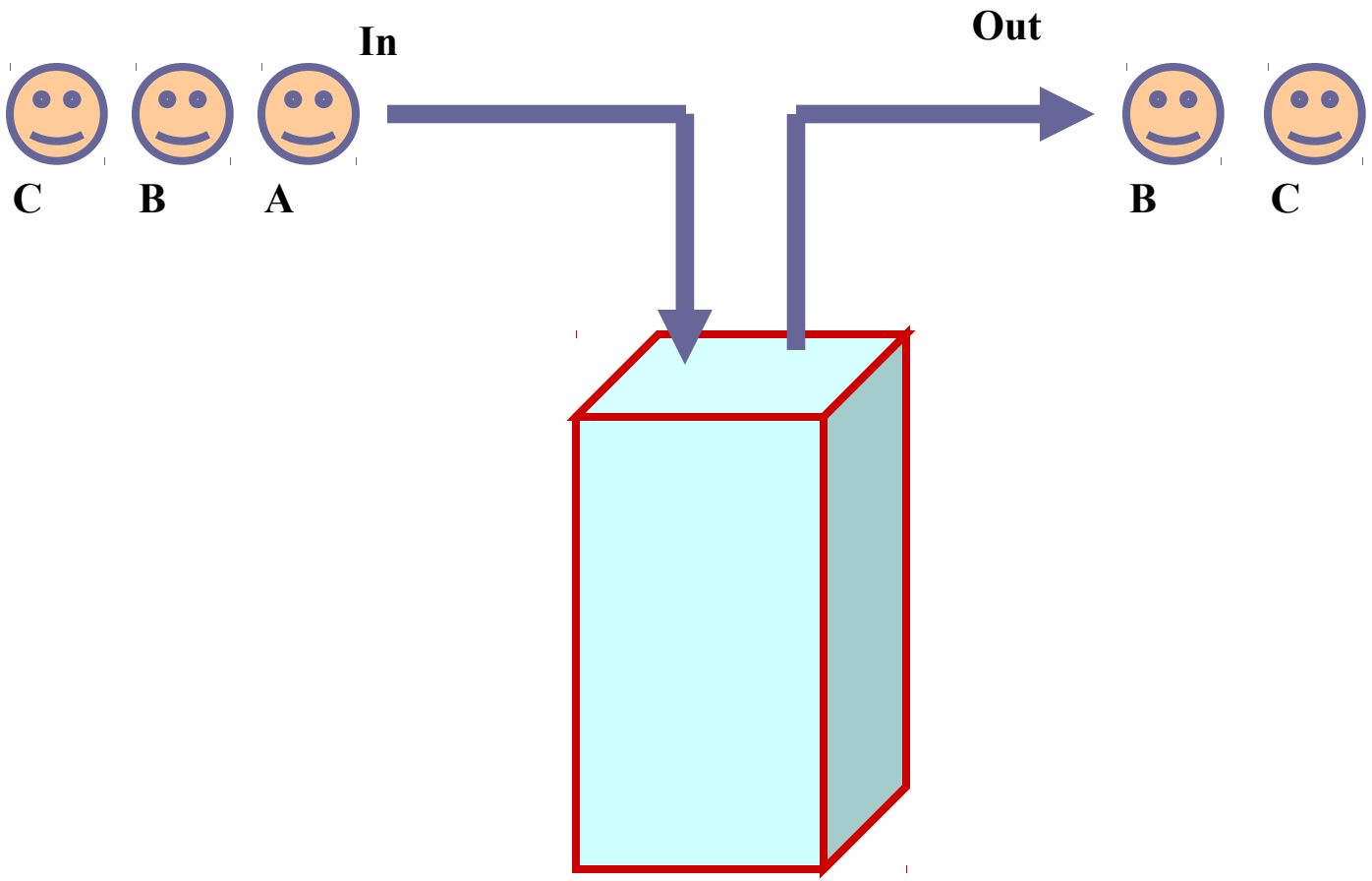
Stack



Stack: *Definition*

```
#define MAX_STACK_SIZE 100

typedef struct {
  int key;
  /* other fields */
}  element;

typedef struct {
        element list[MAX_STACK_SIZE];
        int top;
 } stack;

 stack z;          /* Declaration */
 z.top = -1;       /* Initialization */
```

Stack: *Operations*

```
void push( stack *s, element item )
{
        if (s-> top >= MAX_STACK_SIZE -1) { stack_full( ); return; }
        (s->top)++;
        s->list[s->top] = item;
}

element pop( stack *s )
{
        element item;
        if (s->top = -1) return stack_empty( );
        item = s->list[s->top];
        (s->top)--; return item;
}
```

Application: *Parenthesis Matching*

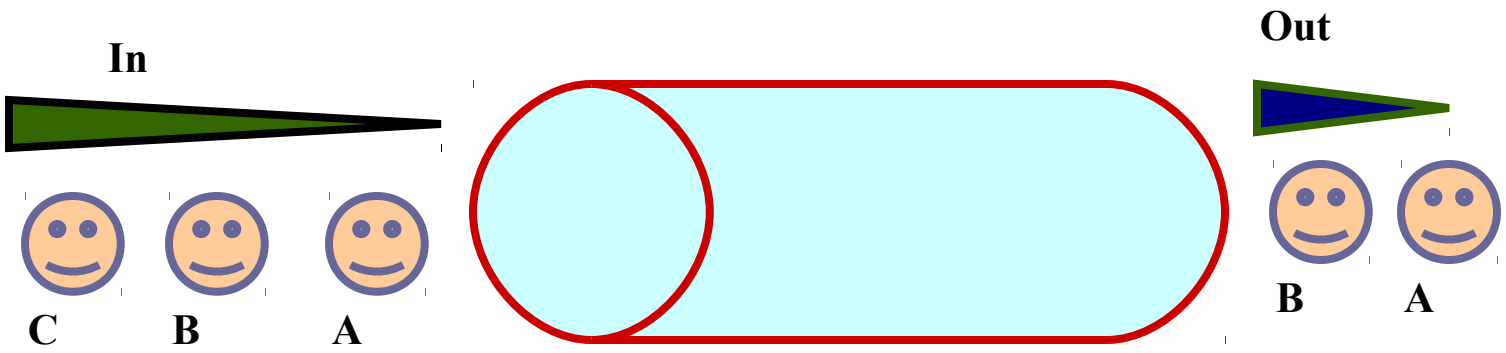
- Given a parenthesized expression, test whether the expression is properly parenthesized.
  - Examples:
  - ()({}[({}{}())]) is proper
  - (){[] is not proper
  - ({)} is not proper
  -)([] is not proper
  - ([])) is not proper

- Approach:
  - Whenever a left parenthesis is encountered, it is pushed in the stack.
  - Whenever a right parenthesis is encountered, pop from stack and check if the parentheses match.
  - Works for multiple types of parentheses ( ), { }, [ ]

Parenthesis matching

```
while (not end of string) do
{
      a = get_next_token();
      if (a is '(' or '{' or '[') push (a);
      if (a is ')' or '}' or ']')
      {
      if (is_stack_empty( )) { print ("Not well formed"); exit(); }
            x = pop();
            if (a and x do not match) { print ("Not well formed"); exit(); }
       }
}
if (not is_stack_empty( )) print ("Not well formed");
```

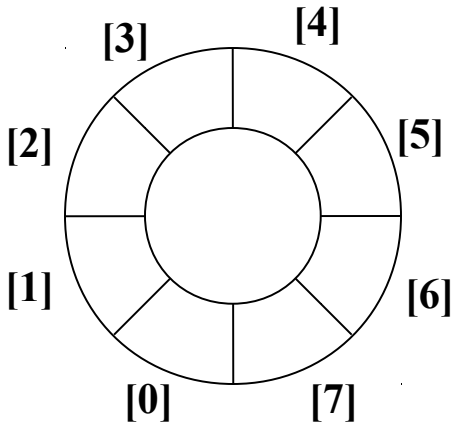
Queue



Queue: *Definition*

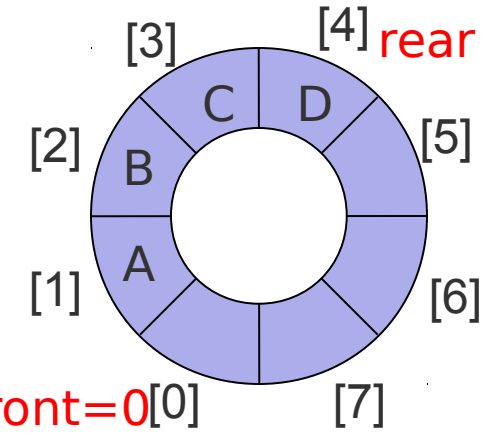
```
#define MAX_QUEUE_SIZE 100

typedef struct {
  int key;
  /* other fields */
}  element;

typedef struct {
        element list[MAX_QUEUE_SIZE];
        int front;
        int rear;
 } queue;

 queue z;          /*Declaration */
 z.front = z.rear = 0;  /* Initialization */
```

Queue: *Circular Implementation*

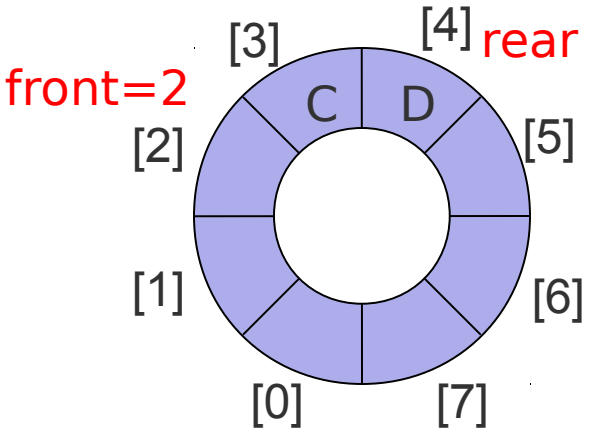


front=0
rear=0

Queue Empty

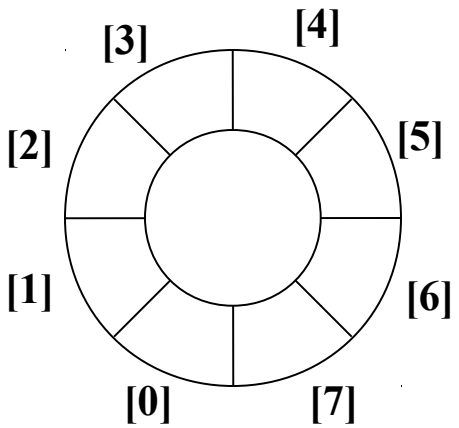


After insertion of A, B, C, D



After deletion of of A, B

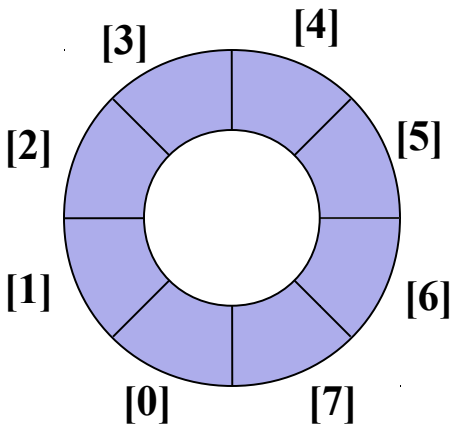
Queue: *Circular Implementation*



front=0
rear=0 Queue Empty

front: ***index of queue-head (always empty – why?)***
rear: ***index of last element, unless rear = front***

rear = 3 **front=4**



Queue Empty Condition: ***front == rear***
Queue Full Condition: ***front == (rear + 1) % MAX_QUEUE_SIZE***

Queue Full

Queue: *Operations*

```
void addq( queue *q, element item )
{
      q->rear = (q->rear  + 1)% MAX_QUEUE_SIZE;
      if (q->front == q->rear) { queue_full( ); return; }
      q->list[q->rear] = item;
}

element deleteq( queue *q )
{
      element item;
      if (q->front == q->rear) return empty_queue( );
      q-> front = (q-> front + 1)% MAX_QUEUE_SIZE;
      return q->list[q->front] ;
}
```