Data Structures

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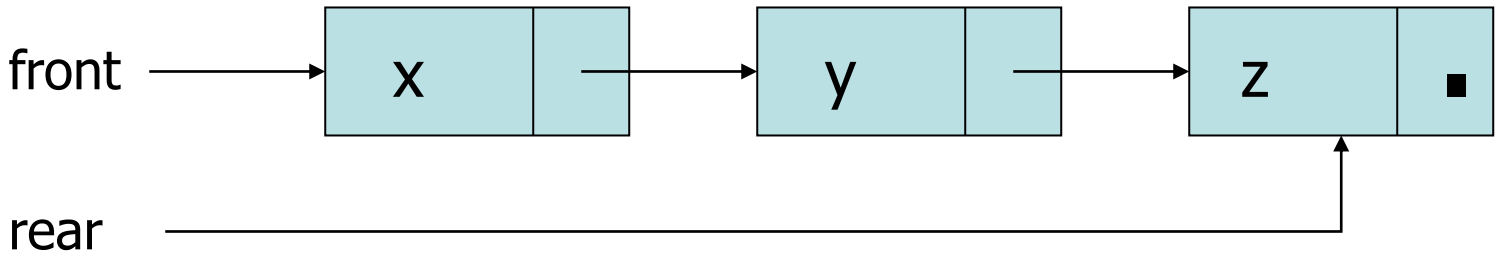
11. Queues Using Linked List

Pointer-based Implementation

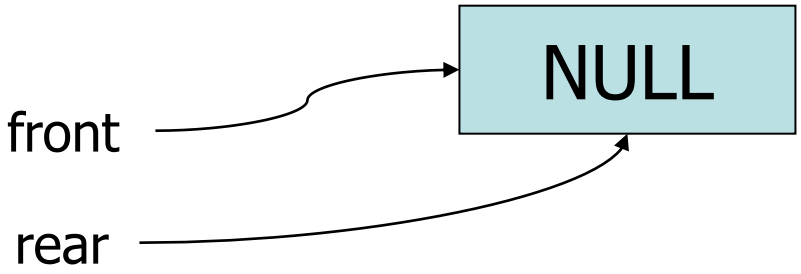
Pointer-Based Implementation of Queues

- Queue Class maintains two pointers
  - `front:` A pointer to the first element of the queue
  - `rear:` A pointer to the last element of the queue

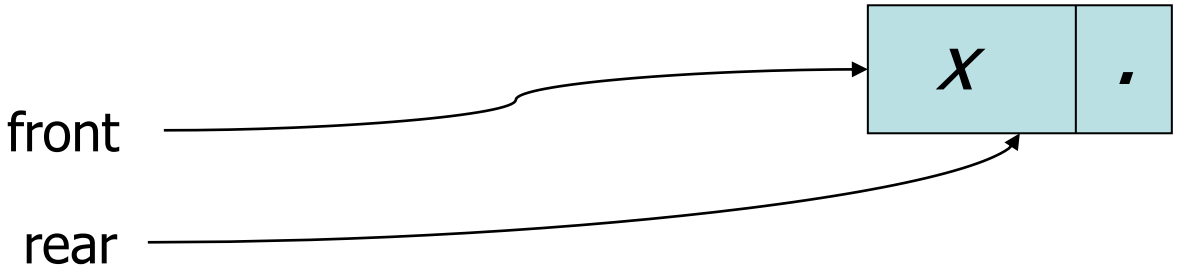


Queue Operations (1)

- `MAKENULL(Q)`

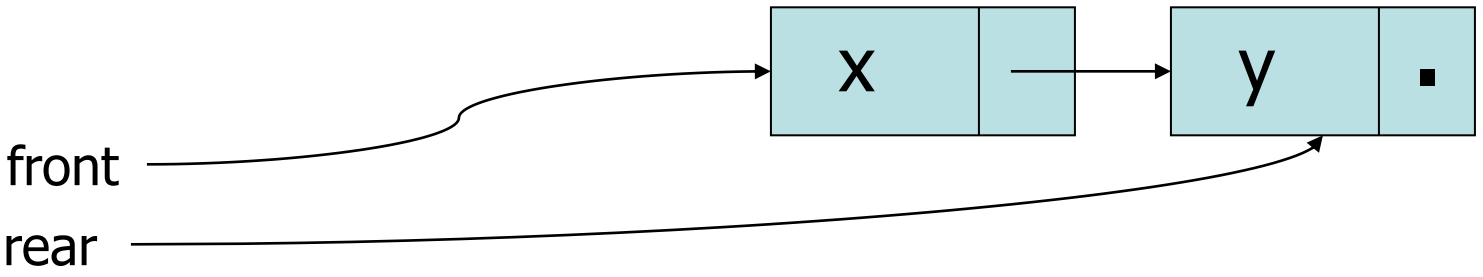


- `ENQUEUE (x, Q)`

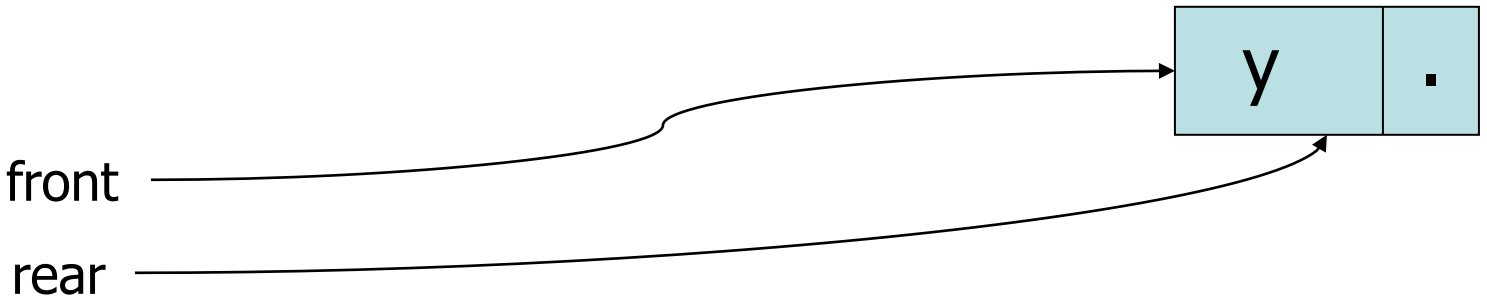


Queue Operations

- `ENQUEUE(y, Q)`



- `DEQUEUE (Q)`



Pointer Implementation – Code (1)

```
class DynIntQueue
{
   private:
      struct QueueNode  // Structure to define linked list node
      {
         int value;
         QueueNode *next;
      };
      QueueNode *front; // pointer to the first node
      QueueNode *rear;  // pointer to the last node
      int numItems;     // Number of nodes in the linked list
   public:
      DynIntQueue(void);
      ~DynIntQueue(void);
      void enqueue(int);
      int dequeue(void);
      bool isEmpty(void);
      void makeNull(void);
};
```

Pointer Implementation – Code (2)

- Constructor

```
DynIntQueue::DynIntQueue(void)
{
   front = NULL;
   rear = NULL;
   numItems = 0;
}
```

- `isEmpty()` returns true if the queue is full and false otherwise

```
bool DynIntQueue::isEmpty(void)
{
   if (numItems)
      return false;
   else
      return true;
}
```

Array Implementation – Code (3)

- Function `enqueue` inserts the value in `num` at the end of Queue

```
void DynIntQueue::enqueue(int num)
{
   QueueNode *newNode;
   newNode = new QueueNode;
   newNode->value = num;
   newNode->next = NULL;
   if (isEmpty()) {
      front = newNode;
      rear = newNode;
   }
   else {
      rear->next = newNode;
      rear = newNode;
   }
   numItems++;
}
```

Array Implementation – Code (4)

- Function `dequeue` removes and returns the value at the front of the Queue

```
int DynIntQueue::dequeue(void)
{
   QueueNode *temp;
   int num = -1;
   if (isEmpty())
      cout << "The queue is empty.\n";
   else {
      num = front->value;
      temp = front->next;
      delete front;
      front = temp;
      numItems--;
      if(!numItems) rear = NULL;
   }
   return num;
}
```

Pointer Implementation – Code (5)

- Destructor

```
DynIntQueue::~DynIntQueue(void)
{
   makeNull();
}
```

- `makeNull()` resets `front` & `rear` indices to `NULL` and sets `numItems` to `0`

```
void DynIntQueue::makeNull(void)
{
   while(!isEmpty()){
      dequeue();
   }
}
```

Using Queues

```
void main(void)
{
   DynIntQueue iQueue;

   cout << "Enqueuing 5 items...\n";
   // Enqueue 5 items
   for (int x = 0; x < 5; x++)
      iQueue.enqueue(x);

   // Deqeue and retrieve all items in the queue
   cout << "The values in the queue were:\n";
   while (!iQueue.isEmpty())
   {
      int value;
      value= iQueue.dequeue();
      cout << value << endl;
   }
}
```

Output:

```
Enqueuing 5 items...
The values in the queue were:
0
1
2
3
4
```

Any Question So Far?