Candidate Number: 2031B
Paper 1
Question 2

a.

Type: float list list

```
let create w m =
    let rec make_row n row i =
        match (i, n) with
        | (k, n) when k=w -> (row, n)
        | (i, a::bs) -> make_row bs (row @ [a]) (i+1)
    in let rec combine_rows m cols =
        match m with
        | [] -> cols
        | _ -> let (row, n) = make_row m [] 0 in combine_rows n (cols @ [row])
    in combine_rows m [];;

let rec get r c m =
    let rec get_row r m =
        match (r, m) with
        | (0, a::bs) -> a
        | (j, a::bs) -> get_row (j-1) bs
    in let rec get_col c row =
        match (c, row) with
        | (0, a::bs) -> a
        | (j, a::bs) -> get_col (j-1) bs
    in let row = get_row r m
    in get_col c row;;
```

get = O(WH)

b.

Type: float array array

```
let create w m =
    let rec populate_row n row i =
        match (i, n) with
        | (k, n) when k=w -> (row, n)
        | (k, a::bs) -> row.(k) <- a; populate_row bs row (k+1)
    in let rec create_rows n matrix i =
        match (i, n) with
        | (k, n) when k*w >= (List.length m) -> matrix
        | (k, n) -
> let (row, p) = populate_row n (Array.make w 0.) 0 in matrix.(k) <- row; crea
te_rows p matrix (k+1)
    in create_rows m (Array.make ( ((List.length m) / w)) [||]) 0;;

let get r c m =
    m.(r).(c);;
```

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get = O(1)

c.

Type: float tree tree

```
let create w m =
    let rec populate_row n row i =
        match (i, n) with
        | (k, n) when k=w -> (row, n)
        | (k, a::bs) -> populate_row bs (update (row,(k+1),a)) (k+1)
    in let rec create_rows n matrix i =
        match (i, n) with
        | (k, []) -> matrix
        | (k, n) -
> let (row, p) = populate_row n Lf 0 in create_rows p (update (matrix,(k+1),ro
w)) (k+1)
    in create_rows m Lf 0;;


let get r c m =
    sub (sub (m, (r+1)), (c+1));;
```

get = O(ln(WH))