שאלה 1.

<u>אפיון לחתימות הפעולות:</u>

Constructors:
$zeros: Integer\ X\ Integer \rightarrow Matrix$
$mul-scalar: Integer\ X\ Matrix \rightarrow Matrix$
$insert: Matrix\ X\ Integer\ X\ Integer\ X\ Integer \rightarrow Matrix$
$add-mat: Matrix\ X\ Matrix \rightarrow Matrix$

Extractors:
$rows: Matrix \rightarrow Integer$
$cols: Matrix \rightarrow Integer$

Predicates:
$is-I?: Matrix \rightarrow Boolean$

Observers:
$print-mat: Matrix \rightarrow ()$

<u>אפיון אלגברי:</u>

<u>For the following, each use in m, n means m, n ∈ N</u>
<u>$M_{i\times j} = \{A \mid A\ is\ a\ i \times j\ matrix\}$</u>
<u>$M_{i\times j}(F)\ represents\ the\ set\ of\ all\ i \times j\ matrices\ over\ F$</u>

- $(zeros\ \ m\ \ n) \quad = O_{i\times j} = M_{ij} = 0\ \ for\ \ 1 \le i \le m\ \ and\ \ 1 \le j \le n$
- $(mul-scalar\ int\ \ MAT\ ) \quad = M_{i\times j} = int \cdot MAT = \left[int \cdot MAT_{ij}\right]$
  $for\ 1 \le i \le (rows\ MAT)\ \ and\ \ 1 \le j \le (cols\ MAT)$
- $(insert\ MAT\ \ a\ \ b\ \ val) \quad = MAT_{ij} = \begin{cases} val, & a = i\ and\ b = j \\ MAT_{ij}, & otherwise \end{cases}$
- $(add-mat\ \ \ MAT_1\ \ MAT_2) \quad = M_{i\times j} = (MAT_1 + MAT_2)_{ij} = MAT_{1_{ij}} + MAT_{2_{ij}}$
  $for\ 1 \le i \le (rows\ mat)\ ,\ \ 1 \le j \le (cols\ mat)\ \ and\ \ MAT_1, MAT_2 \in M_{i\times j}(F)$
  $error\ otherwise$
- $\left(rows\ (zeros\ m\ n\ )\right) \quad = m$
- $\left(cols\ (zeros\ m\ n\ )\right) \quad = n$
- $(is-I?\ \ MAT) = \begin{cases} true, & MAT_{ij} = \begin{cases} 1, & i = j \\ 0, & i \ne j \end{cases} \\ false, & otherwise \end{cases}$
- $(print-mat\ \ MAT) = No\ Return\ Value$