

Determine and Present the Feasibility of Matrix Addition and Multiplication over an Arbitrary Set of Matrices

```
In[28]:= mA = {{0, 3}, {2, 1}};
mB = {{2, -1}, {0, 3}};
mC = {{1, 0, 1, 2}, {2, -1, 3, 1}};
mD = {{1, 1, -1}, {8, 6, -5}};
mE = {{2, 1, 3}, {-1, 6, 2}, {8, 9, 5}, {-4, 6, 1}};
SetAttributes[Map, HoldAll];
matrices = HoldForm /@ {mA, mB, mC, mD, mE};
ClearAttributes[Map, HoldAll];

In[41]:= CheckAddition[lhs_, rhs_] :=
  Dimensions[ReleaseHold[lhs]] == Dimensions[ReleaseHold[rhs]]
CheckMultiplication[lhs_, rhs_] :=
  Dimensions[ReleaseHold[lhs]][[2]] == Dimensions[ReleaseHold[rhs]][[1]]
FormatFeasibilityTable[data_, title_] :=
  Labeled[
    Labeled[data,
      {Style["RHS", ShowStringCharacters → False, Bold],
       Style["LHS", ShowStringCharacters → False, Bold]},
      {Top, Left},
      RotateLabel → True,
      Frame → True,
      FrameMargins → Large],
    Style[title, ShowStringCharacters → False, Underlined],
    Top, Spacings → {Automatic, 1}
  ]

In[44]:= rawTableData =
  TableForm[Outer[#, matrices, matrices],
    TableHeadings → {matrices, matrices} & /@
    {CheckAddition, CheckMultiplication};
```

Remark: Matrix addition is commutative due to the commutativity of addition in the element's fields.

```
In[45]:= FormatFeasibilityTable[##[[1]], ##[[2]]] & /@
  {{rawTableData[[1]], "Addition Feasibility Table"},
   {rawTableData[[2]], "Multiplication Feasibility Table"}}
```

Out[45]= { LHS

RHS					
	mA	mB	mC	mD	mE
mA	True	True	False	False	False
mB	True	True	False	False	False
mC	False	False	True	False	False
mD	False	False	False	True	False
mE	False	False	False	False	True

,

LHS

RHS					
	mA	mB	mC	mD	mE
mA	True	True	True	True	False
mB	True	True	True	True	False
mC	False	False	False	False	True
mD	False	False	False	False	False
mE	False	False	False	False	False

}