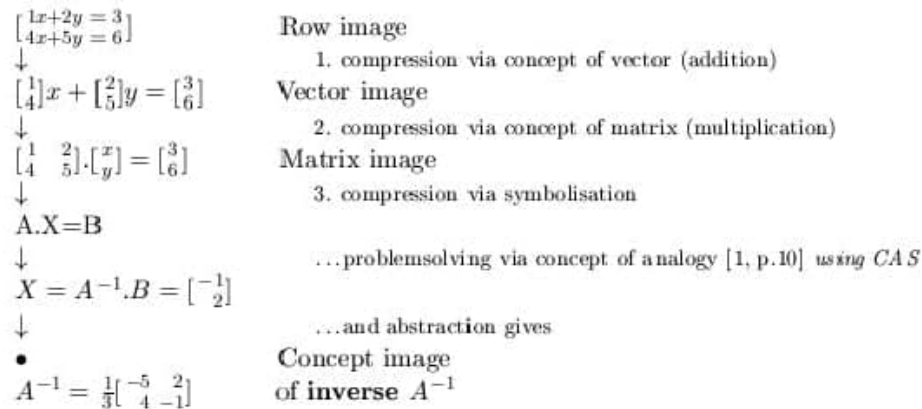


2B Concept formation according to APOS theory

Try to identify the individual A-P-O-S phases in the following sequence of steps to *form the concept of the inverse matrix* to an invertible matrix A:



Exercise:

- a) First test and explain the following interactive EIGENMATH mini learning environment (LE) to support *the formation of the concept of the inverse matrix* as shown above:

```
# EIGENMATH
A = ((1,2),(4,5))
X = (x,y)
B = (3,6)           -- dot(.)=..*..
dot(A,X)             -- LHS of linear system A*X=B
X = dot(inv(A),B)    -- X = 1/A*B = A^(-1)*B
dot(A,X) == B        -- verify solution X = A^-1*B
```

Note: EIGENMATH use *dot* for the scalar/matrix product and *inv(A)* for the inverse matrix A^{-1} .

- b) In your opinion, what exploration opportunities are offered to the student in the above CAS-LE? Which *phenomena* could be specifically observed? In what respect is this LE *interactive*? What additional didactical and methodological options are there compared to a CAS-free access to the formation of the concept „inverse matrix“?
- c) Design a small A.C.E cycle based on the above CAS-LE to form the concept of the inverse matrix.
- d) Construct an A.C.E cycle within a suitable CAS-LE to create a concept for a self-chosen concept from linear algebra/analytic geometry or analysis.

Invoke Eigenmath here: <https://georgeweigt.github.io/eigenmath-demo.html>

References:

- [1] DUBINSKY, E., and McDONALD, M.: APOS: A Constructivist Theory of Learning in UME Research. o. O., 2000
- [2] DUBINSKY, E., and TALL, D.: Advanced Mathematical Thinking and the Computer. In *Advanced Mathematical Thinking*, D. Tall, Ed., vol. 5. Kluwer, Dordrecht, 1991, pp. 231–250.
- [3] TALL, D., and VINNER, S.: Concept Images and Concept Definition in Mathematics with Particular reference to Limits and Continuity. *Educational Studies in Mathematics*, 12 (1991), 49–63

Translated into English (wL) 2/2021. Use EIGENMATH instead of MuPAD