01204211 Discrete Mathematics
Lecture 10a: Applications

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Factory Production

A food factory can produce 2 products: a sleeping candy bar (S) and an energy bar (E).

- There are two ingredients: A and B. The factory has 120 units of A and 100 units of B.
- To produce 1 unit of candy bar S, you need 15 units of A and 10 units of B.
- To produce 1 unit of energy bar E, you need 10 units of A and 20 units of B.

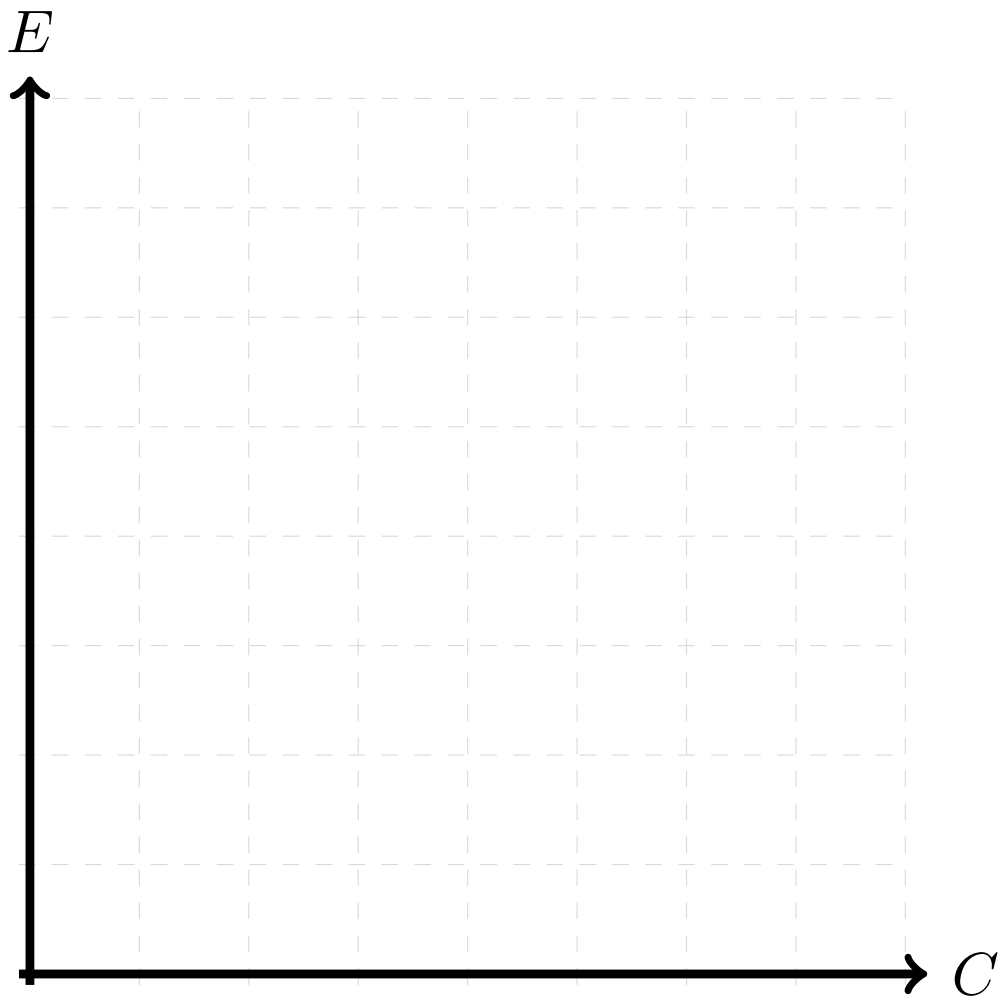
How can we visualize the problem?

Factory Production

A food factory can produce 2 products: a sleeping candy bar (C) and an energy bar (E).

- There are two ingredients: A and B. The factory has 120 units of A and 100 units of B.
- To produce 1 unit of candy bar C, you need 15 units of A and 10 units of B.
- To produce 1 unit of energy bar E, you need 10 units of A and 20 units of B.

How can we visualize the problem?

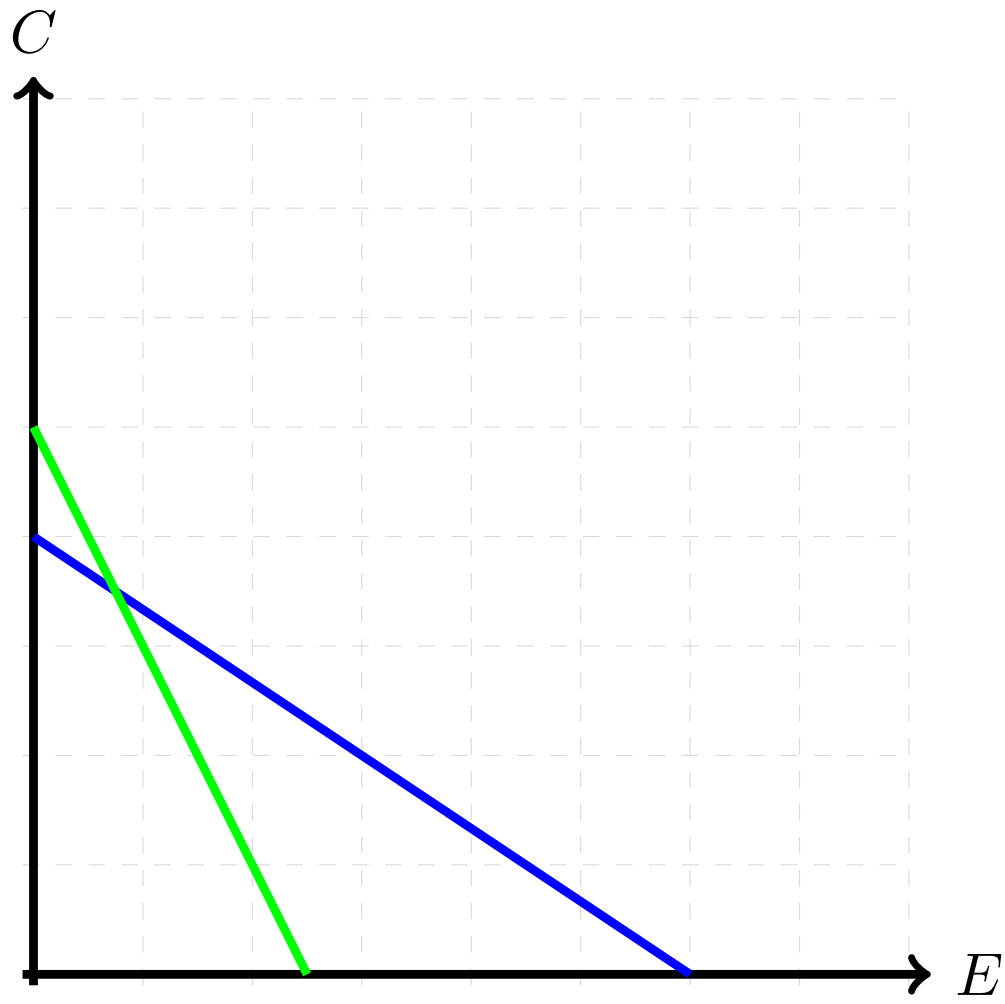


Factory Production

How can we choose the amount of C and E to produce?

It depends on the prices per unit of C and E.

What if 1 unit of C is 1 baht and 1 unit of E is also 1 baht?



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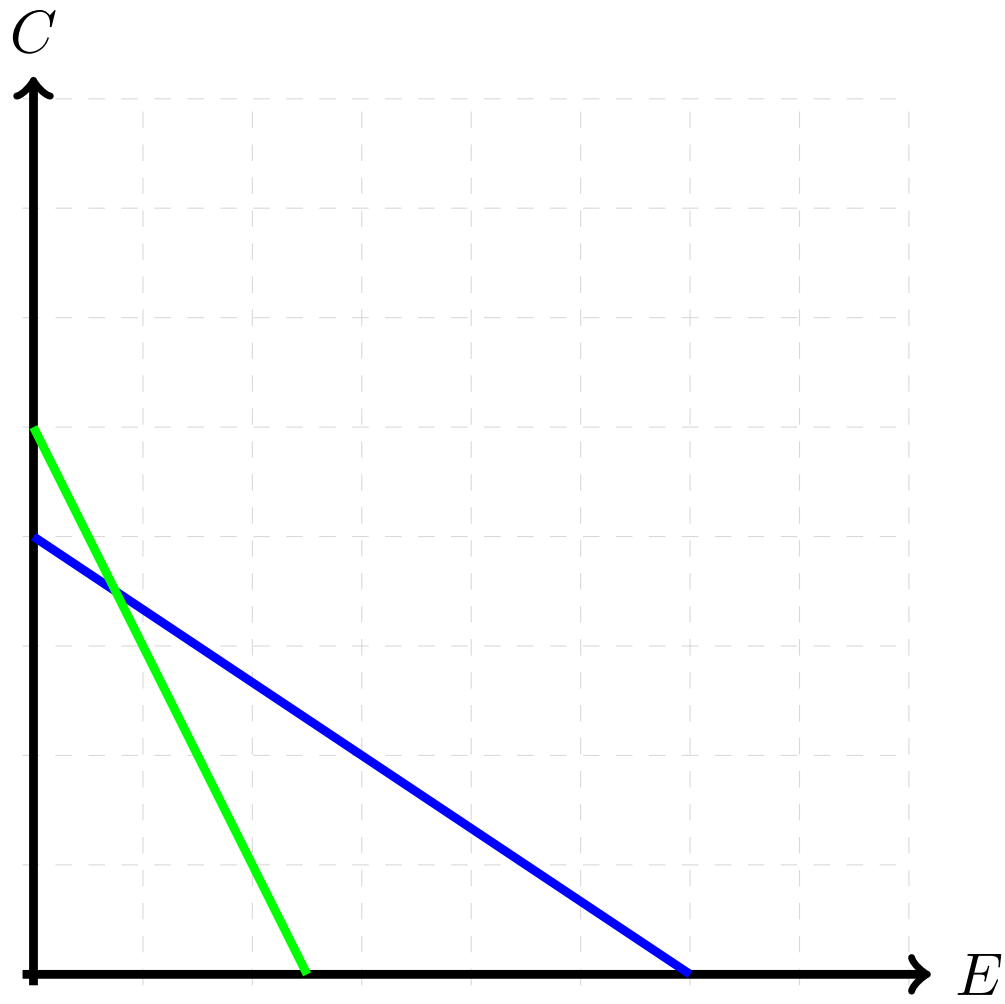
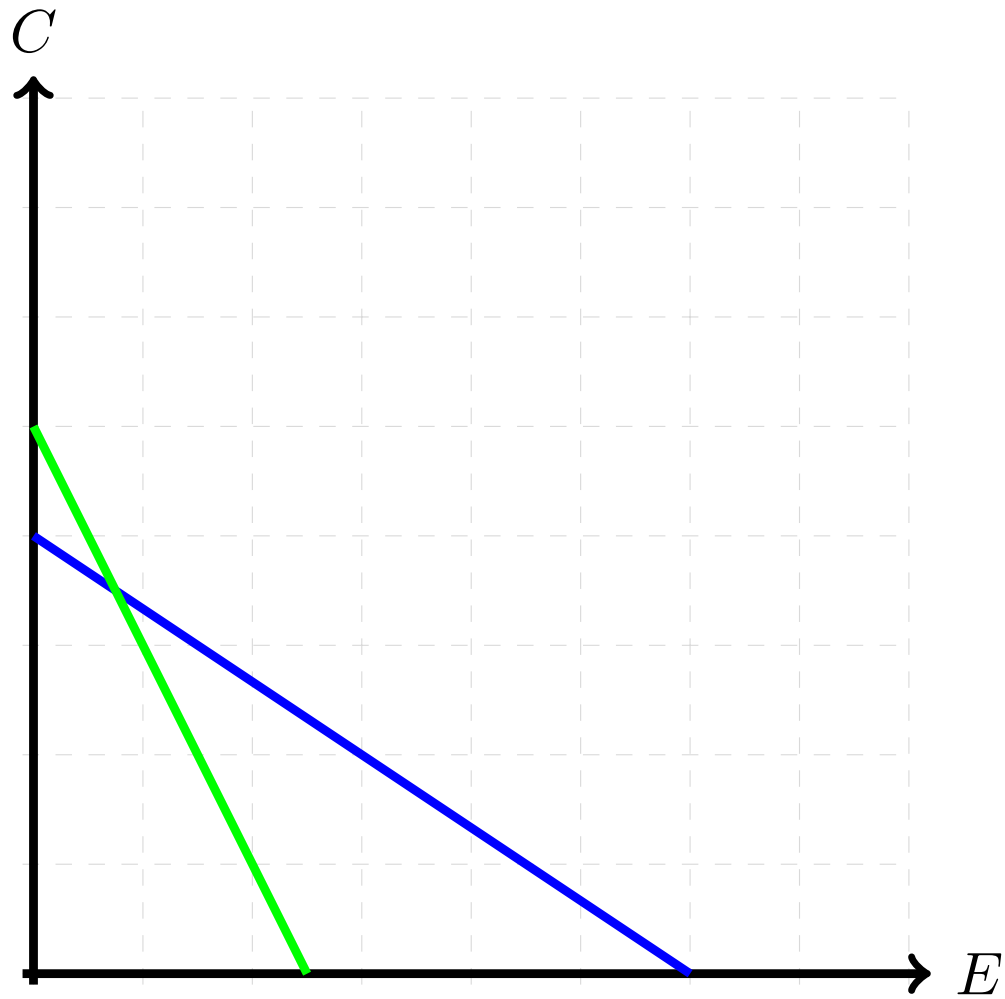


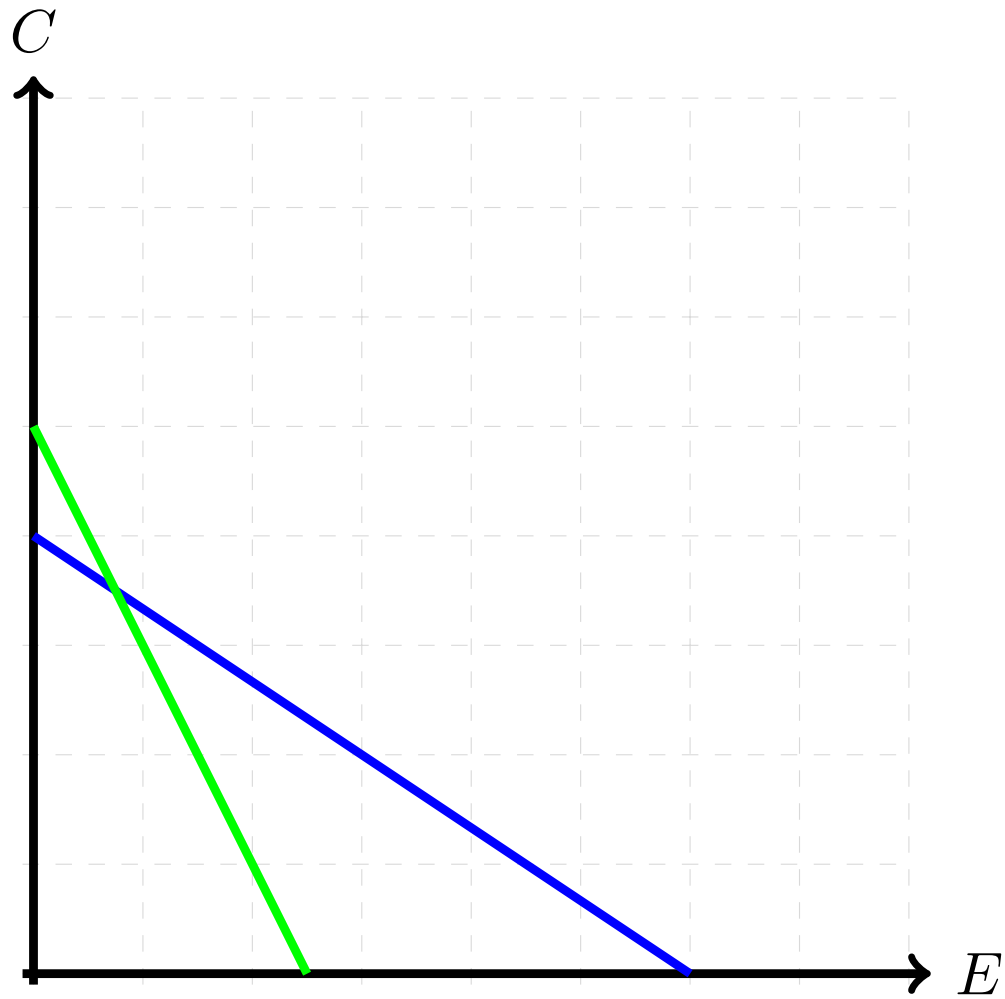
Factory Production

What if 1 unit of C is 10 baht and 1 unit of E is also 1 baht?



Factory Production

What if 1 unit of C is 1 baht and 1 unit of E is also 10 baht?



Objective functions

If we produce x_1 units of C and x_2 units of E, we would make

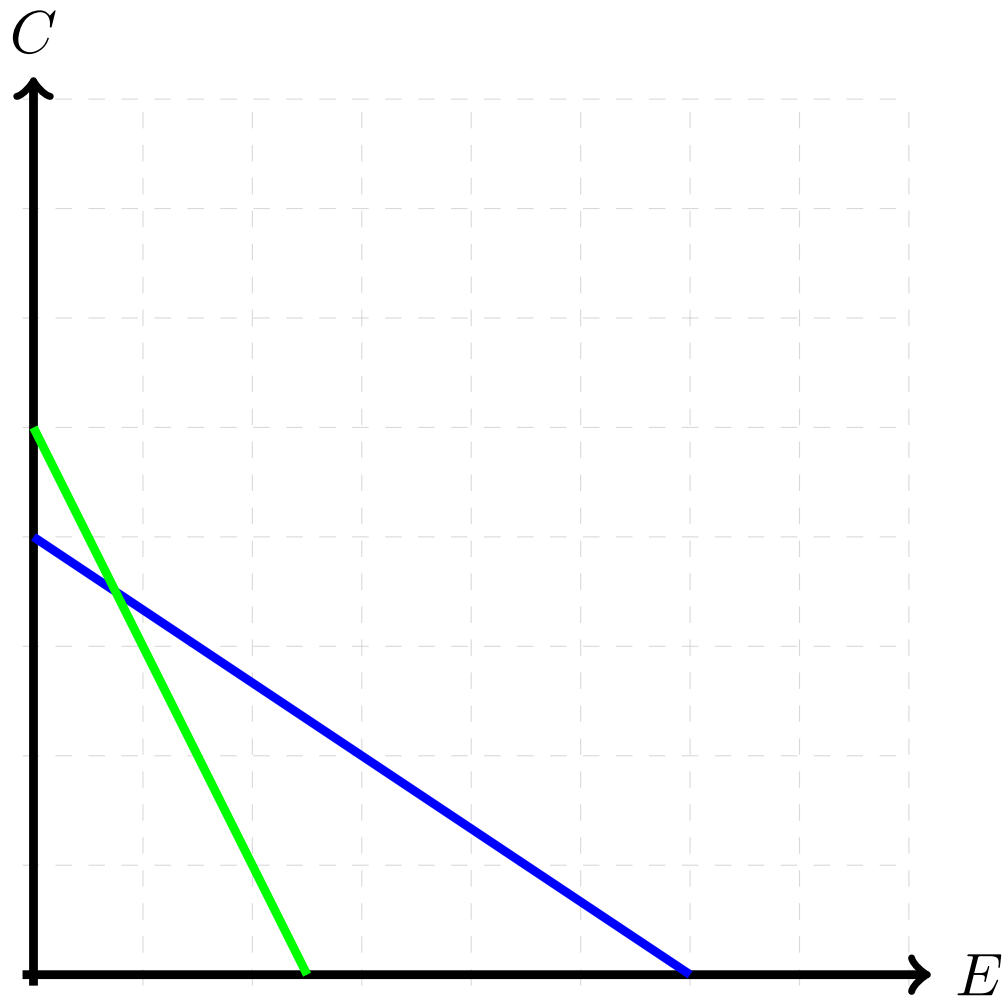
$$p_C \cdot x_1 + p_E \cdot x_2,$$

where p_C and p_E are unit prices for C and E.
This is called an objective function. So far, we tried 3 objective functions:

- $x_1 + x_2$
- $10 \cdot x_1 + x_2$
- $x_1 + 10 \cdot x_2$

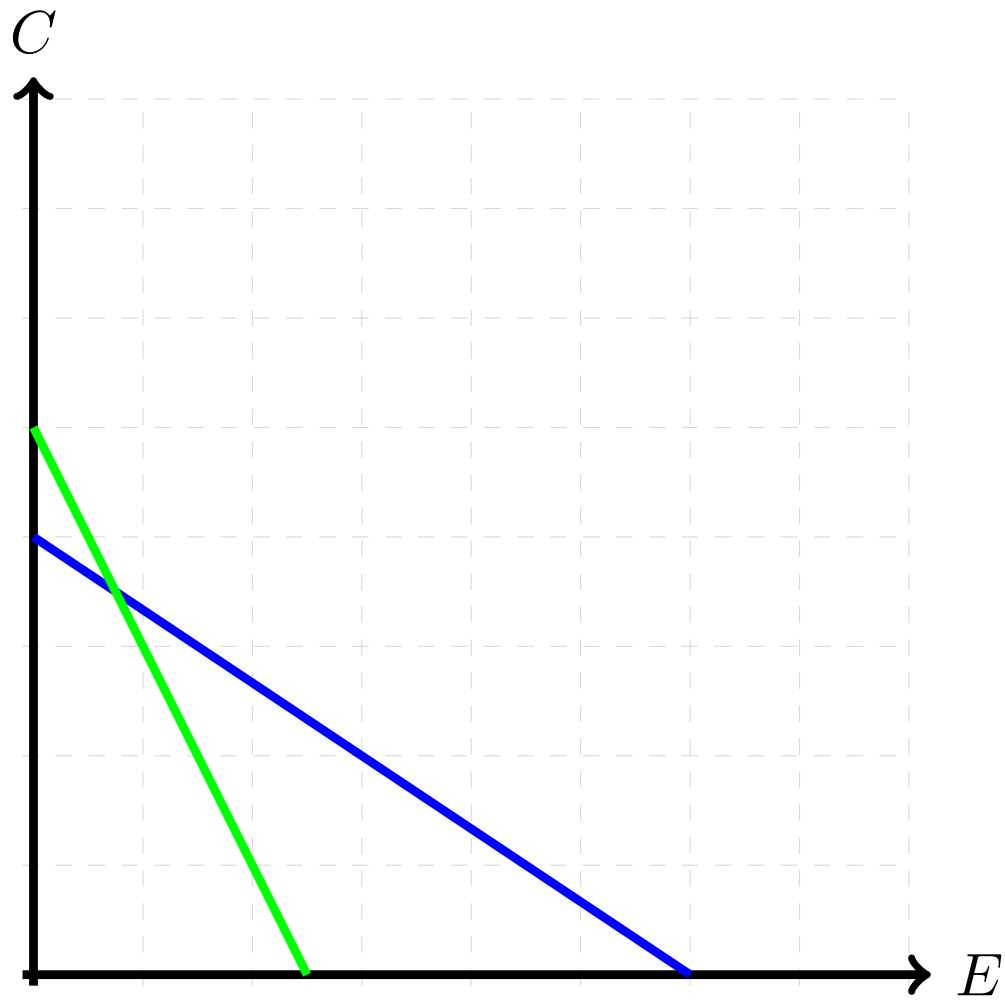
Objective functions

Let's see what they look like again.

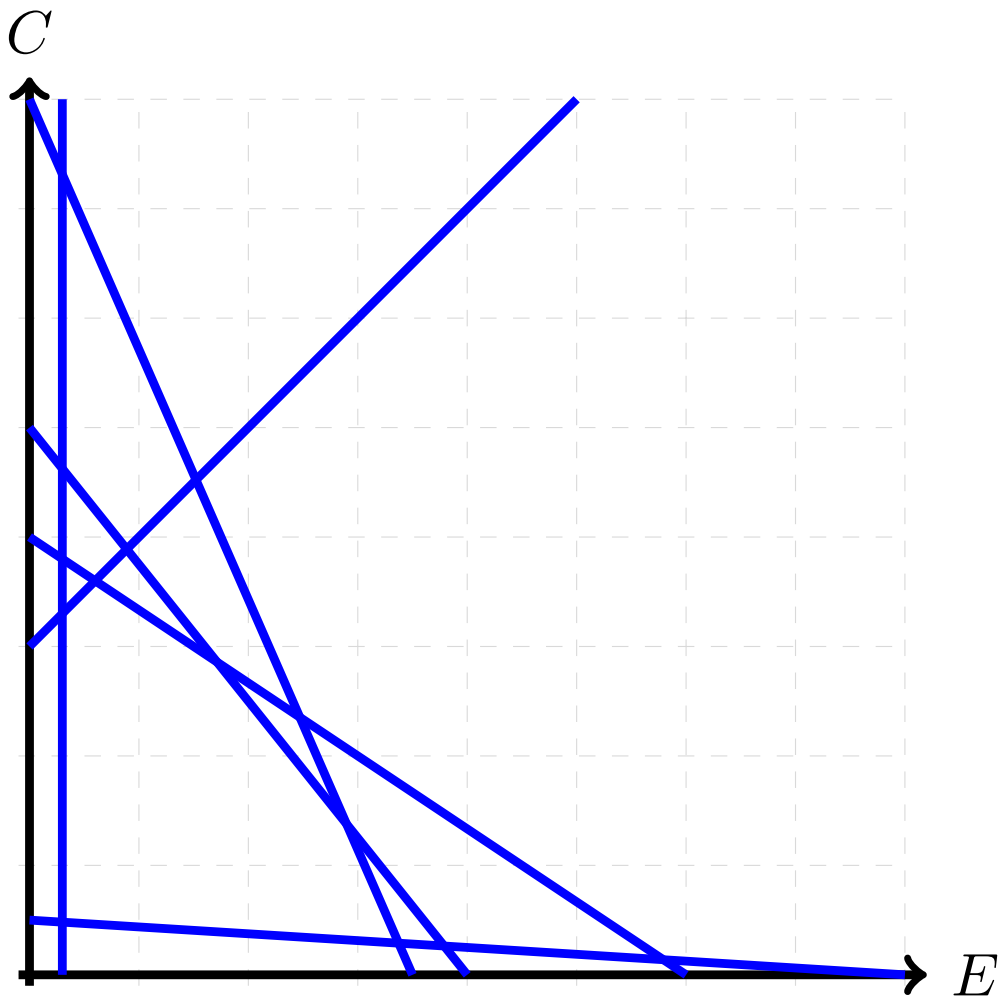


Vertices

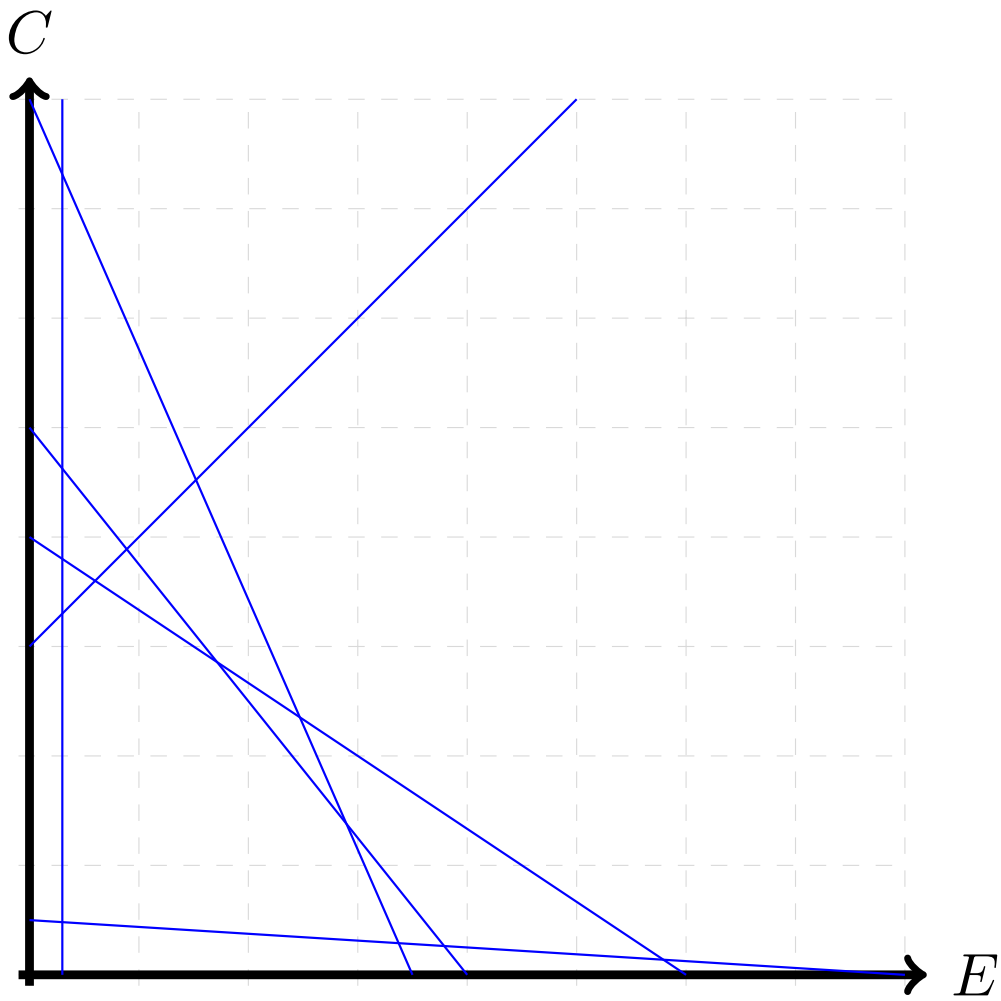
Interesting things happen at the intersections. What are they?



Simplex algorithm



Simplex algorithm - How do you move?



A quick history of machine learning

- Perceptrons
- Neural networks
- Convolutional neural networks

Perceptrons

- Invented in 1943 by McCulloch and Pitts.
- Implemented by Rosenblatt in 1958 (The Perceptron algorithm).

Perceptrons: Training the weights

Perceptrons: XOR limit and multilayer perceptrons

Neural networks

Inspiration from visual cortex study

Convolutional neural networks