An example:

Calculate value of at the money European call
- ▶ matures in one year
- ▶ strike price of 100
- ▶ underlying stock pays no dividends
- ▶ has annual volatility of 20%
- ▶ risk free interest rate is 10% per year.

In the slides we calculate the option value using the B-S model.

$$O_{c,0} = 13.27$$

Assume now a Binomial mode with 2-periods. How to calculate the option value?

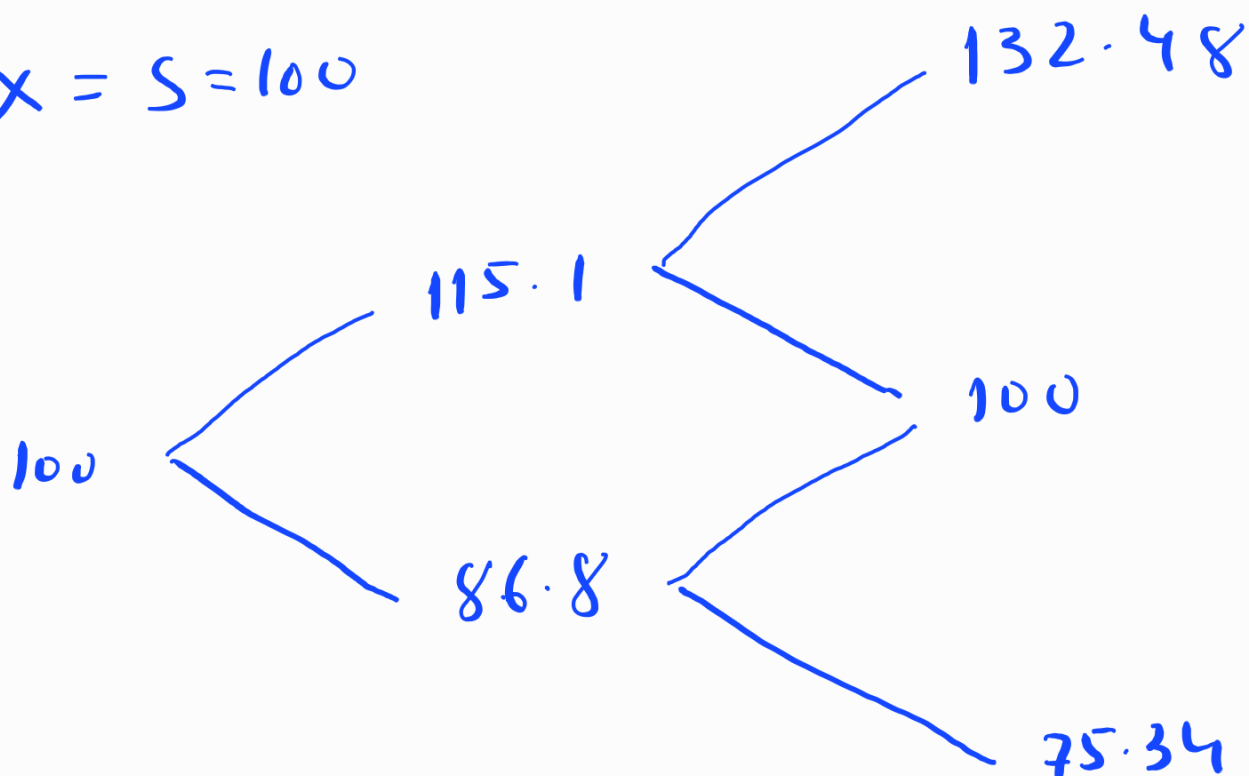$$u = e^{\sigma \sqrt{\delta t}} = e^{0.2 \times \sqrt{0.5}} = 1.151$$

$$d = e^{-\sigma \sqrt{\delta t}} = e^{-0.2 \times \sqrt{0.5}} = 0.868$$

$$p = \frac{e^{0.1 \times \delta t} - e^{-\sigma \sqrt{\delta t}}}{e^{\sigma \sqrt{\delta t}} - e^{-\sigma \sqrt{\delta t}}} = 0.645$$

$$(1-p) = 0.355$$

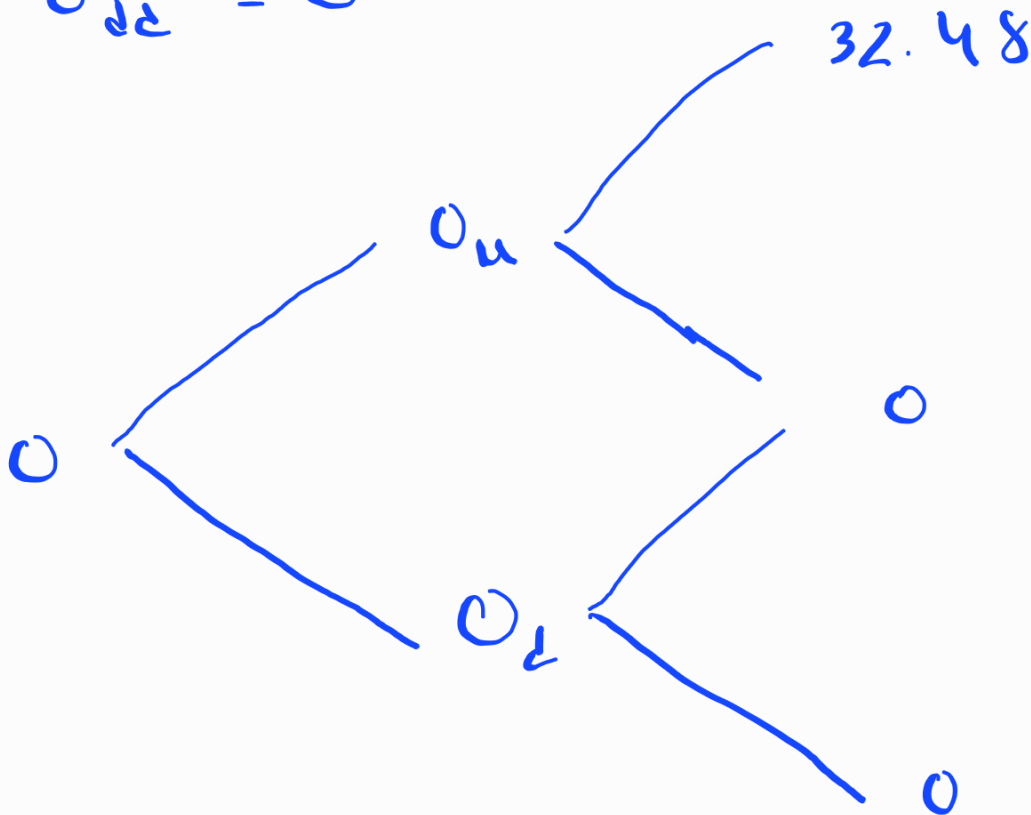$$0 = \frac{p^2 \, O_{uu} + 2(1-p) \, O_{ud} + (1-p)^2 \, O_{dd}}{n^2}$$

$$X = S = 100$$

$$O_{uu} = \max(S_{uu} - X, O) = 32.48$$

$$O_{ud} = O$$

$$O_{dd} = O$$

$$O_u = \frac{32.48 \times 0.645 + O}{e^{0.1 \times 0.5}} = 19.9279$$

$$O_d = O$$

$$O = \frac{19.9279 \times 0.645 + O}{e^{0.1 \times 0.5}} = 12.2266$$