Curves

- Which of the following curves could be a ROC?
- Which could be a Lift chart?
Curves

• Which of the following curves could be a ROC?
  – Answer: all, excepted the orange one: TPR and FPR (on the axes) never decrease

• Which could be a Lift chart?
  – Answer: as for ROC, but now also the red one is impossible: you need to classify as positive several records (X axis) to reach 100% of TPR (Y axis)
Bagging

- We have 3 independent models for the same data, with poor performances
  - Error1 = 45%
  - Error2 = 40%
  - Error3 = 35%

- Is it better to use Model3 alone or to make bagging with all the three models?
Bagging

- TODO: compute the probability of error of the ensemble
- Standard formula (case for 25 models):

\[
\sum_{i=13}^{25} \binom{25}{i} \varepsilon^i (1 - \varepsilon)^{25-i}
\]

- Implicitly enumerates all cases with more errors than correct answers (i >= 13 errors against 25-i <=12 correct ones)
  - However, it works only when all models have the same error \(\varepsilon\)
- Here we have to explicitly enumerate all cases
Bagging

- Probability of success and failure of each:
  - Model1 = \( \cdot 0.45 \) and \( \cdot 0.55 \)
  - Model2 = \( \cdot 0.40 \) and \( \cdot 0.60 \)
  - Model3 = \( \cdot 0.35 \) and \( \cdot 0.65 \)
Bagging

• We have 8 possible cases

Model1 | Model2 | Model3
---|---|---
✔️ | ✔️ | ✔️
✔️ | ❌ | ✔️
✔️ | ✔️ | ✔️
✔️ | ❌ | ✔️
✔️ | ✔️ | ✔️
✔️ | ❌ | ✔️
✔️ | ✔️ | ✔️
✔️ | ❌ | ✔️

- Model1 = 0.45, 0.55
- Model2 = 0.40, 0.60
- Model3 = 0.35, 0.65
Bagging

- We have 8 possible cases

Model1 | Model2 | Model3
\- Model1 = 0.45 | 0.55
\- Model2 = 0.40 | 0.60
\- Model3 = 0.35 | 0.65

In these cases the Bagging makes errors.
Bagging

- We have 8 possible cases

Model1 | Model2 | Model3
--- | --- | ---
[Green Check] | [Green Check] | [Green Check]
[Green Check] | [Red X] | [Green Check]
[Red X] | [Green Check] | [Red X]
[Red X] | [Red X] | [Red Check]

- Model1 = .45
- Model2 = .40
- Model3 = .35

Total: 0.3515

$P = .55\times.40\times.35 = 0.0770$
$P = .45\times.60\times.35 = 0.0945$
$P = .45\times.40\times.65 = 0.1170$
$P = .45\times.40\times.35 = 0.0630$
Bagging

• Outcome:
  – The “expert” model (Model3) has 35% of error
  – The bagging model has 35.15% of error
  – In this specific case Bagging is not better than the “expert” alone...
Wisdom of the crowd

Which of the following question-answering methods might work, thanks to the wisdom of the crowd? Why?

- Predict the precipitation (rain) level in Sydney by asking to all my neighbors
- Estimate the average length of taking a degree in CS by asking to all the people in this room
- Writing an high quality review of a movie by asking to several friends who saw only the trailer
- Understand if vaccination is good by asking to all my contacts on Facebook (several hundreds)
Keep an eye on requirements...

• Diversity of opinion.
  – People in crowd should have a range of experiences, education and opinions. (Encourages independent predictions)

• Independence.
  – Prediction by person in crowd is not influenced by other people in the crowd.

• Decentralization.
  – People have specializations and local knowledge.

• Aggregation.
  – There is a mechanism for aggregating all predictions into one single prediction.