Limitations of linear models
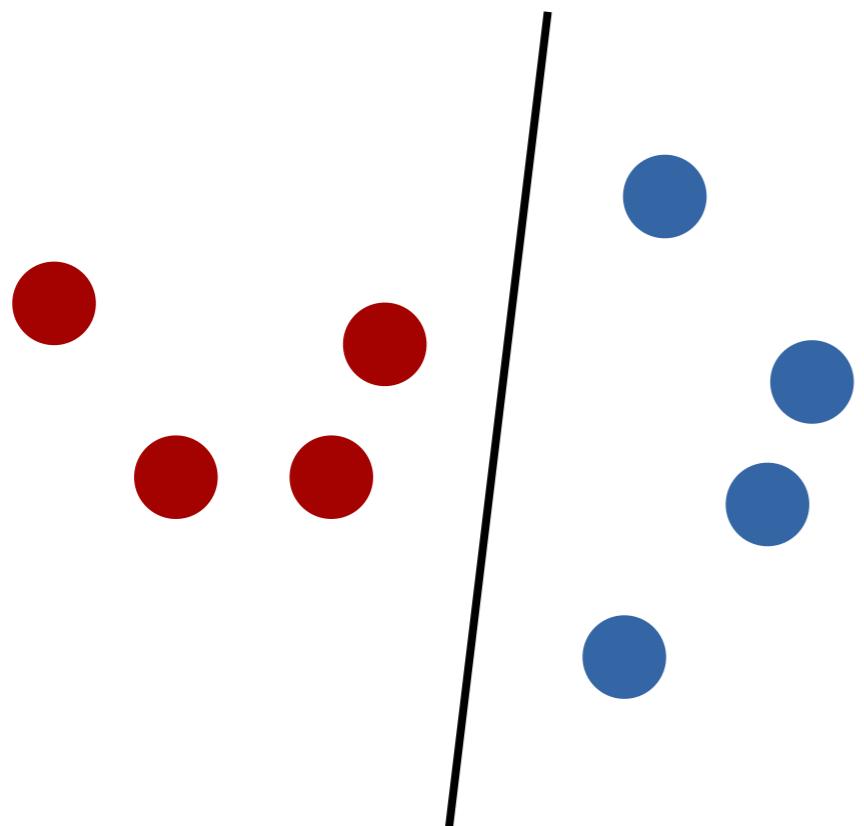
Linear classifier

Linear classifier
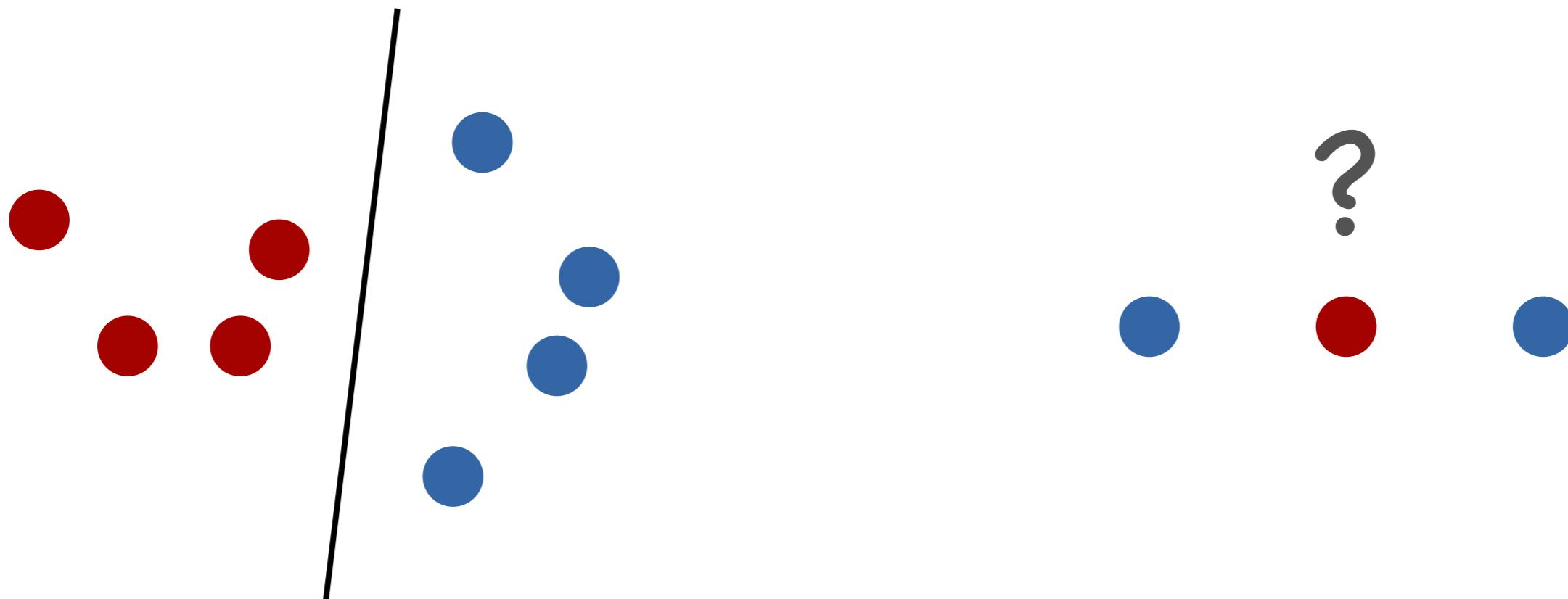
A simple example

- Binary paw classification

  - Dog paw or not
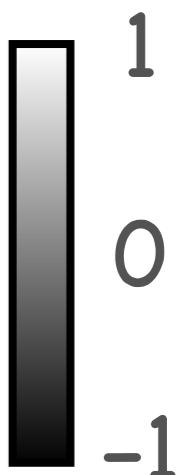
A simple example

Why does the linear model break?

- By linearity:

  - $\mathbf{w}^\top \mathbf{x}_1 + b > 0$

    $\mathbf{w}^\top \mathbf{x}_2 + b > 0$

  - Then $\mathbf{w}^\top \mathbf{x} + b > 0$
    for any $\mathbf{x} = \alpha \mathbf{x}_1 + (1 - \alpha)\mathbf{x}_2$

- Cannot learn xor
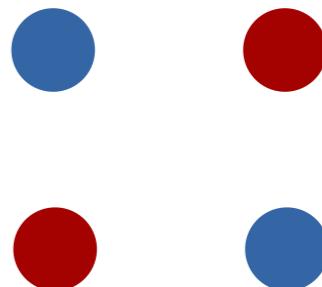
Does adding more linear layers help?

- No

- Combination of linear layers still linear

    - $\mathbf{W}_2(\mathbf{W}_1\mathbf{x} + \mathbf{b}_1) + \mathbf{b}_2$
    $= (\mathbf{W}_2\mathbf{W}_1)\mathbf{x} + (\mathbf{W}_2\mathbf{b}_1 + \mathbf{b}_2)$

Linear

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Linear

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Linear

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