

# Data Mining

## Regras de Classificação

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UFSM  
2022

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# Notas legais

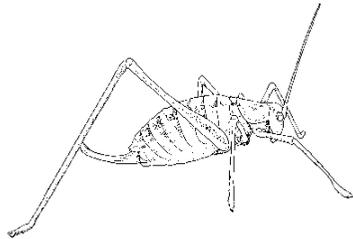
- Este material foi cedido pelo Dr. Eamonn Keogh (University of California - Riverside, US) para as aulas de mineração de dados na UFSM.
- Se você deseja usar este material para outros fins, entre em contato com o autor ([eamonn@cs.ucr.edu](mailto:eamonn@cs.ucr.edu)).

Tradução e adaptação: Dr. Joaquim Assunção ([joaquim@inf.ufsm.br](mailto:joaquim@inf.ufsm.br)).

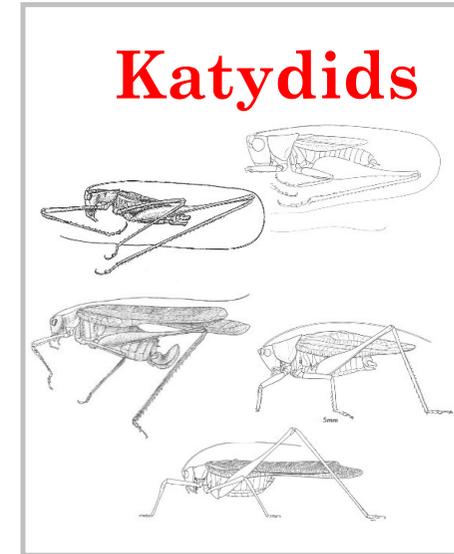
# Problema de Classificação

## Uma definição informal

Dada uma coleção de dados anotados.  
Neste caso, 5 instâncias de *Katydid*  
(gafanhoto A) e 5 *Grasshoper* (gafanhoto B).  
Decida que tipo de inseto o exemplo não  
rotulado é.



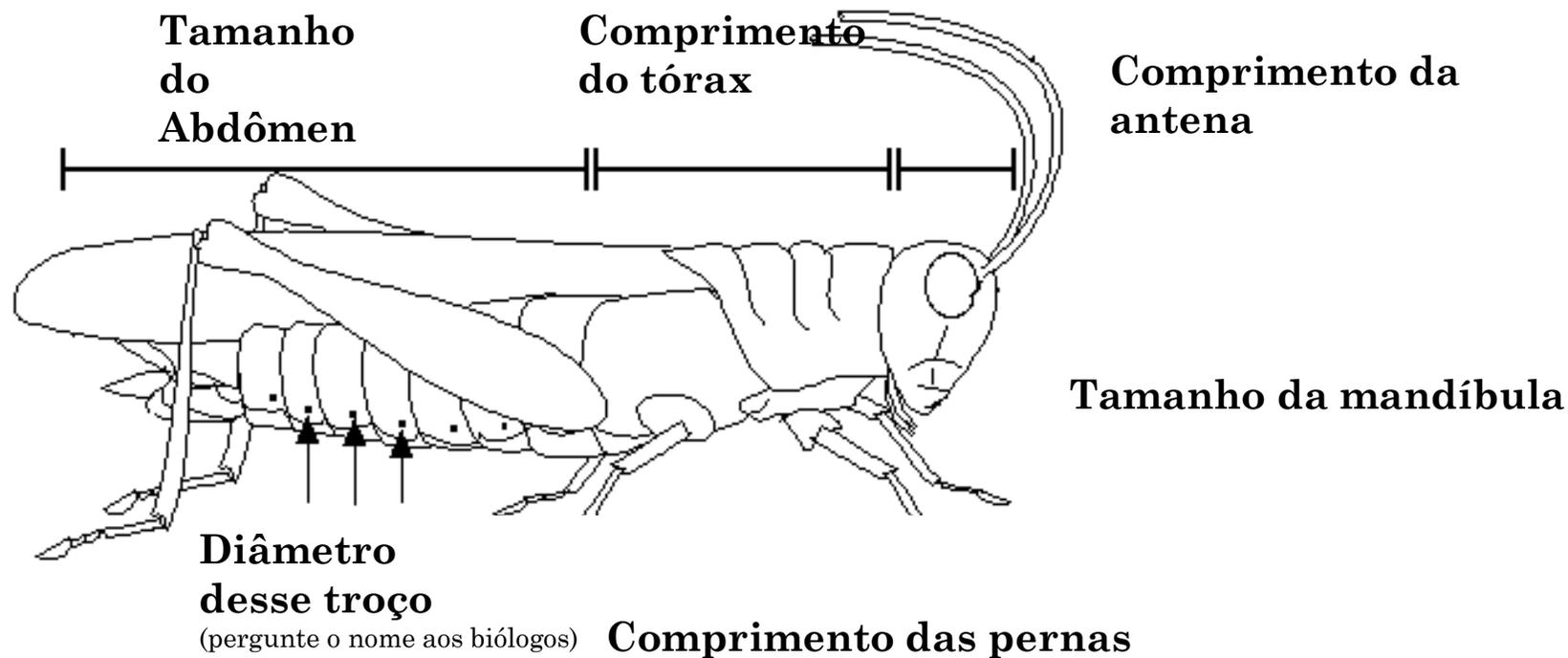
**Katydid** or **Grasshopper**?



# Para cada domínio de interesse, podemos medir as características

Cor {Verde, Cinza, Marrom, Outra}

Tem azas?



## Minha\_Colecao

Podemos usar características em um conjunto de dados.

O problema de classificação agora pode ser expressado como:

- Dado um conjunto de treino (**Minha\_Colecao**), Descubra o rótulo da **classe** de uma Instância nunca vista (inseto novo)

Inseto ID	Abdômen	Antena	Classe do inseto
1	2.7	5.5	Grasshopper
2	8.0	9.1	Katydid
3	0.9	4.7	Grasshopper
4	1.1	3.1	Grasshopper
5	5.4	8.5	Katydid
6	2.9	1.9	Grasshopper
7	6.1	6.6	Katydid
8	0.5	1.0	Grasshopper
9	8.3	6.6	Katydid
10	8.1	4.7	Katydid

Inseto novo =

11

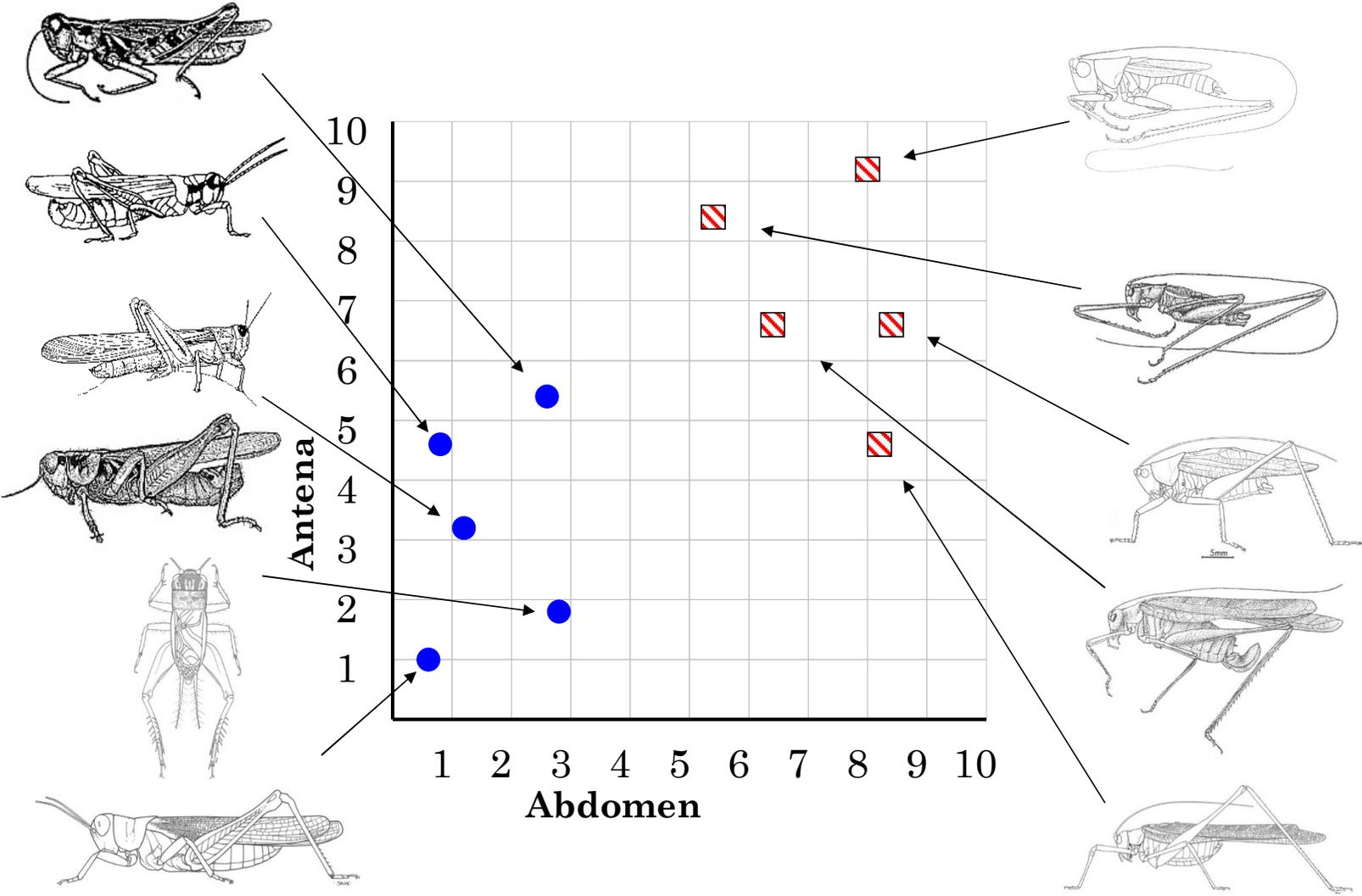
5.1

7.0

???????

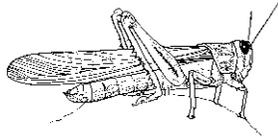
# Grasshoppers

# Katydid

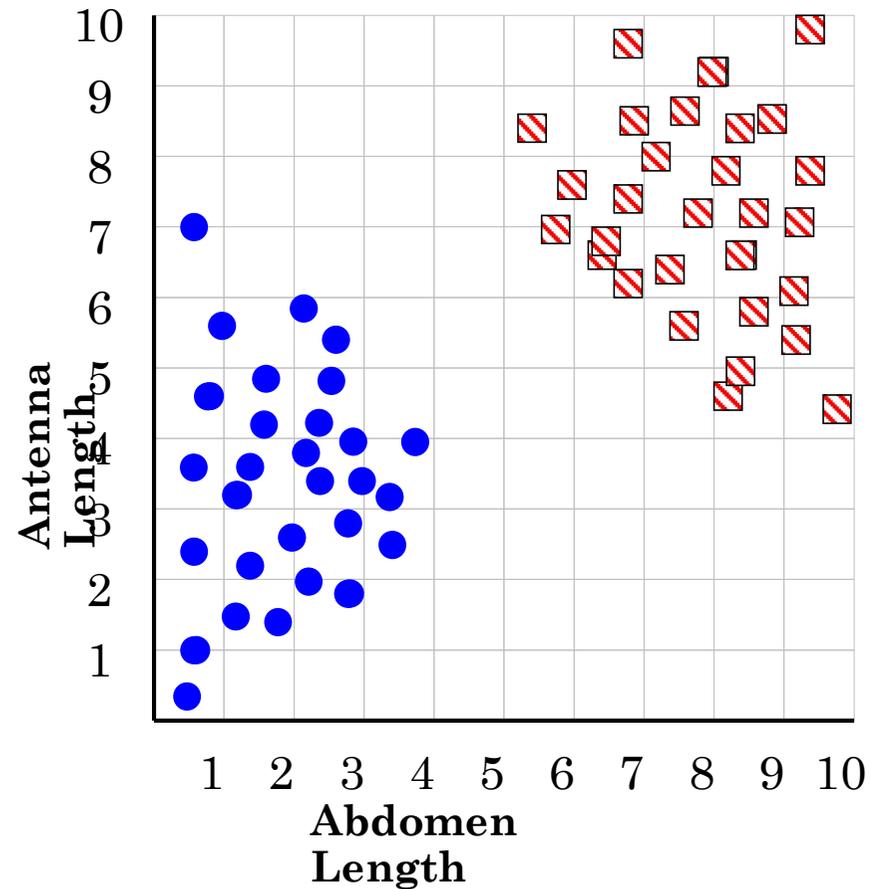


Adaptado do original de Dr. Eamonn Keogh. (University of California - Riverside, US)

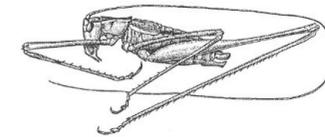
# Grasshoppers



Vamos usar esse conjunto,  
ligeiramente, maior como exemplo...



# Katydidids



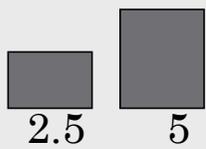
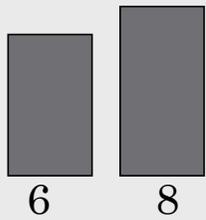
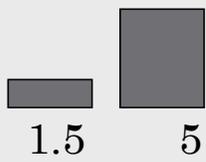
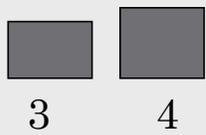
Cada um destes  
objetos de dados  
são chamados  
de...

- exemplares
- exemplos de  
treino
- instâncias
- tuplas

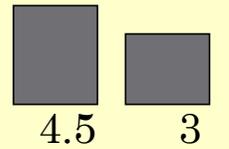
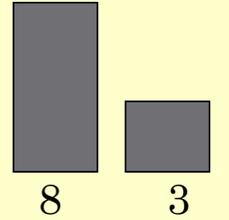
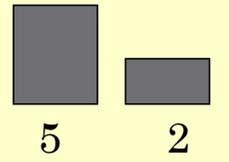
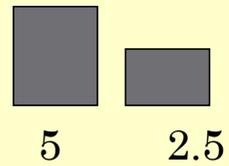
Voltaremos em breve.  
Agora, vamos Jogar...

# Jogo #1

## Exemplos da classe A

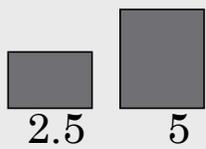
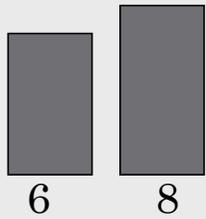
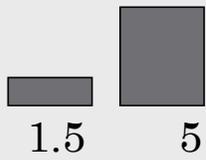
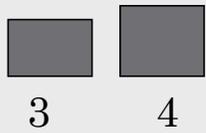


## Exemplos da classe B

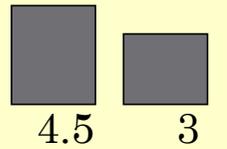
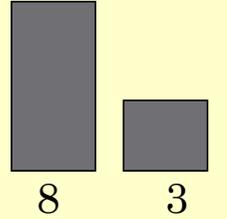
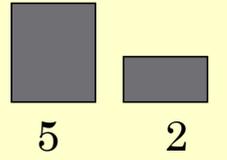
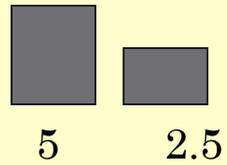


# Jogo #1

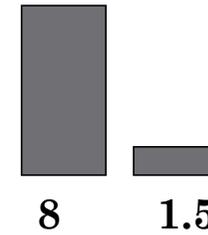
## Exemplos da classe A



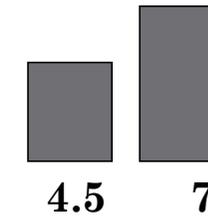
## Exemplos da classe B



Que classe de objeto é essa?

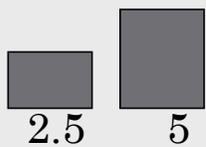
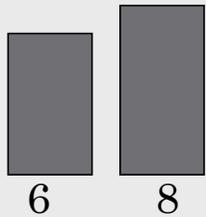
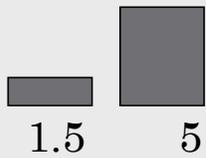


E essa, A or B?

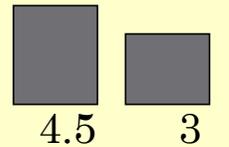
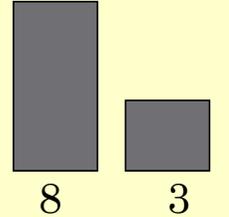
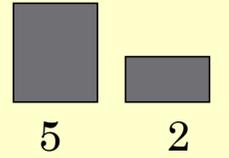
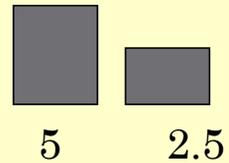


# Jogo #1

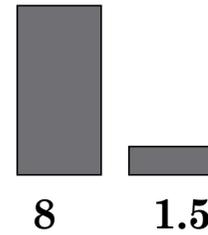
## Exemplos da classe A



## Exemplos da classe B



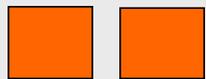
É **B**!



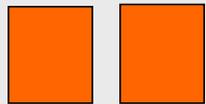
Aqui está a regra, se o primeiro valor for menor que o segundo é **A**, caso contrario é **B**.

# Jogo #2

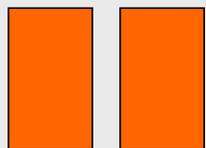
## Exemplos da classe A



4 4



5 5

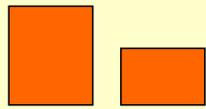


6 6

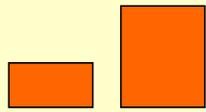


3 3

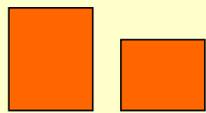
## Exemplos da classe B



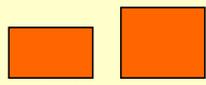
5 2.5



2 5

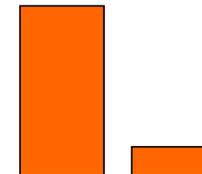
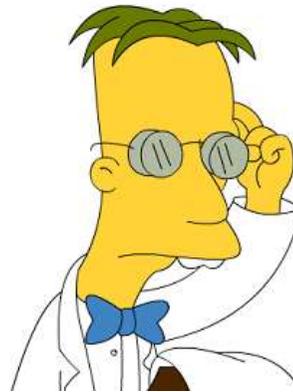


5 3



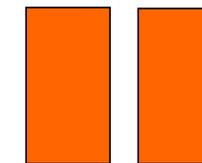
2.5 3

Humm! Éssa é difícil!



8 1.5

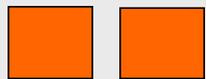
Até eu sei essa



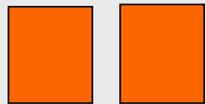
7 7

# Jogo #2

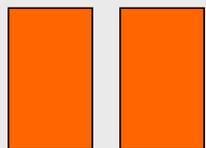
## Exemplos da classe A



4 4



5 5

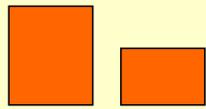


6 6

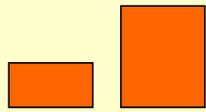


3 3

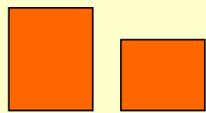
## Exemplos da classe B



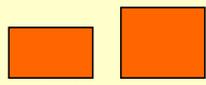
5 2.5



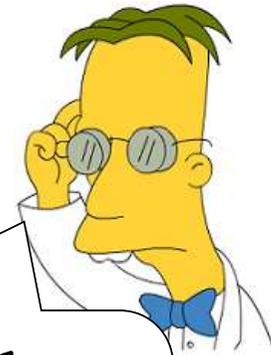
2 5



5 3

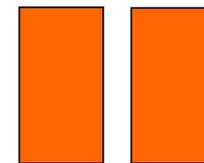


2.5 3



Aqui está a regra, se as barras forem de tamanhos iguais é um **A**. Caso contrário é **B**.

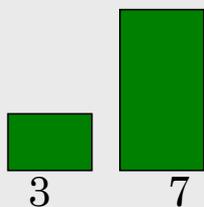
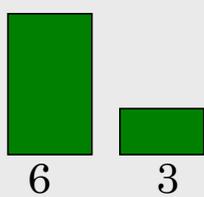
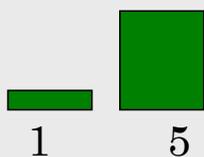
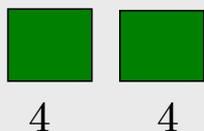
É um **A**! Sou um Gênio.



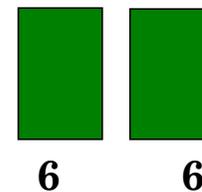
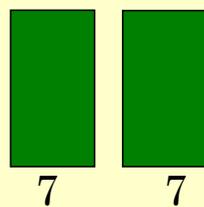
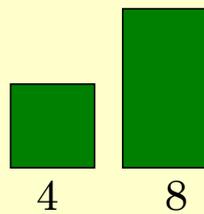
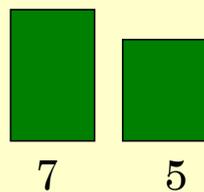
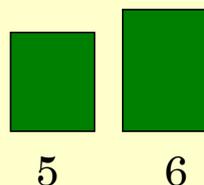
7 7

# Jogo #3

## Examplos da classe A



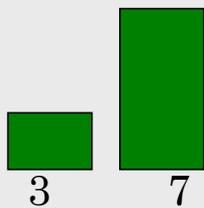
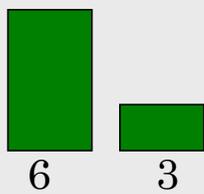
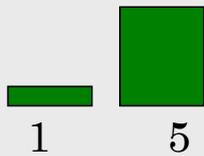
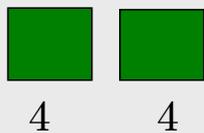
## Examplos da classe B



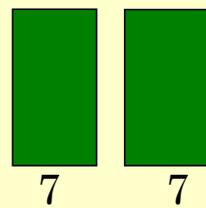
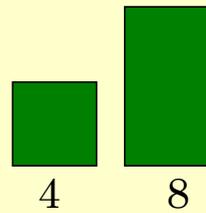
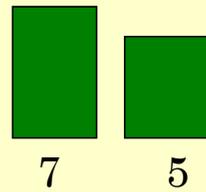
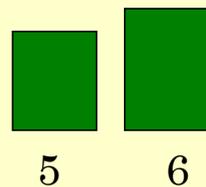
Putz, essa é realmente difícil...  
A ou B?

# Jogo #3

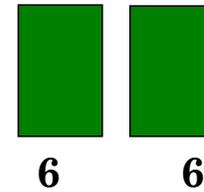
## Examplos da classe A



## Examplos da classe B



É um **B**!



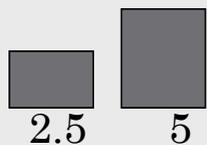
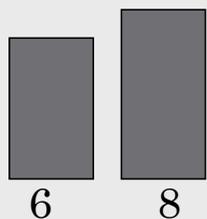
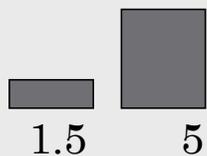
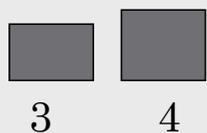
A regra é a seguinte: Se o quadrado da soma das barras for menor ou igual a 100, é um **A**. Caso contrário é um **B**.

As regras fazem sentido, mas  
não estou certo quanto a  
exclusividade das mesmas...  
vontade de assistir os Simpsons

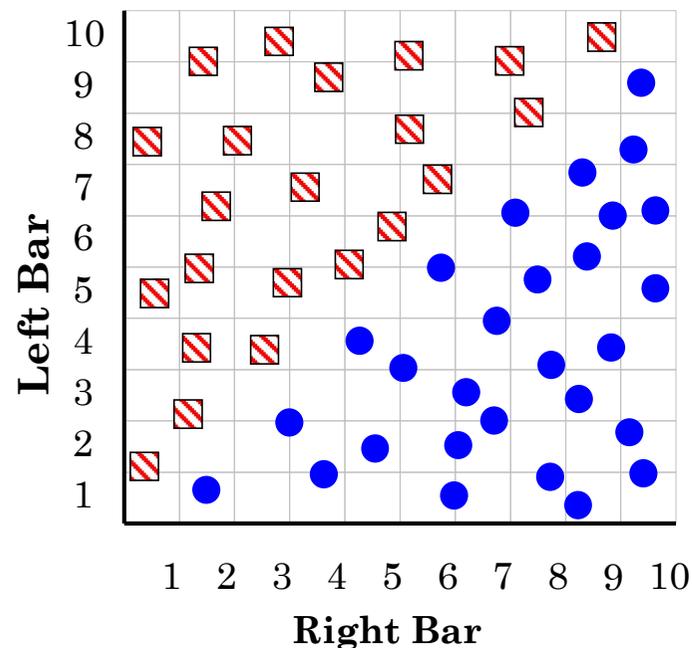
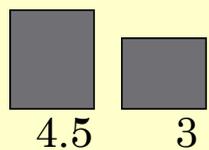
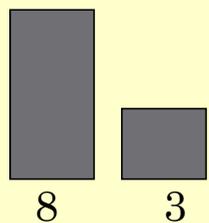
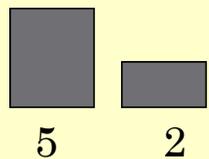
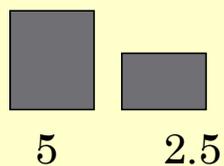


# Jogo #1

Exemplos da classe A



Exemplos da classe B



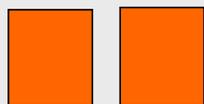
Relembrando a regra.  
Se a barra esquerda for menor que a direita é **A**,  
caso contrário é **B**.

# Jogo #2

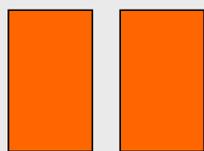
## Exemplos da classe A



4 4



5 5

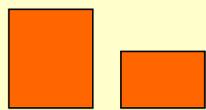


6 6

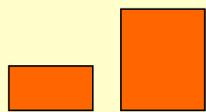


3 3

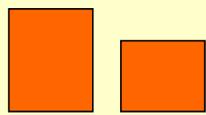
## Exemplos da classe B



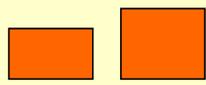
5 2.5



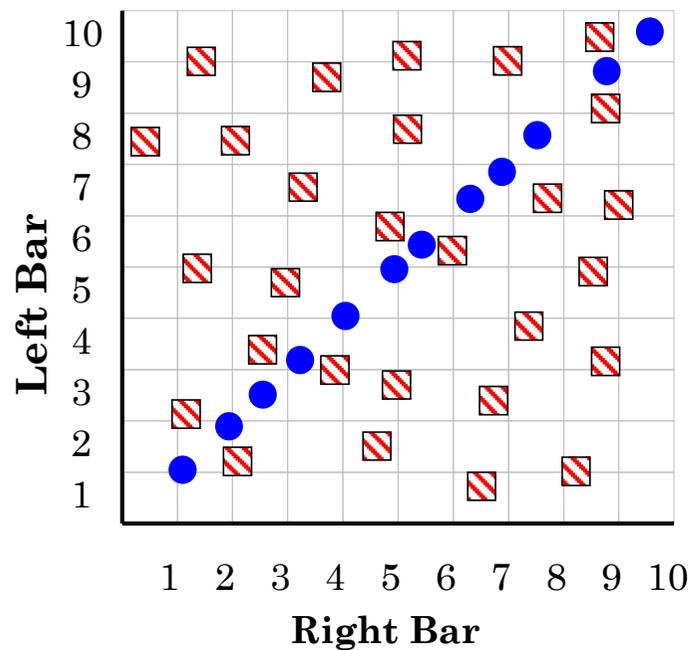
2 5



5 3



2.5 3

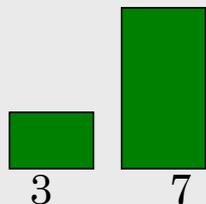
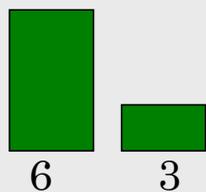
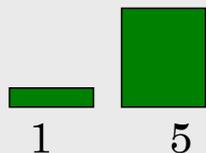
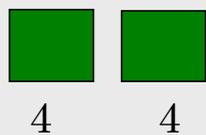


Deixa eu ver... aqui, achei! .. A regra é, se as duas barras tiverem o mesmo tamanho é **A**. as outras são **B**.

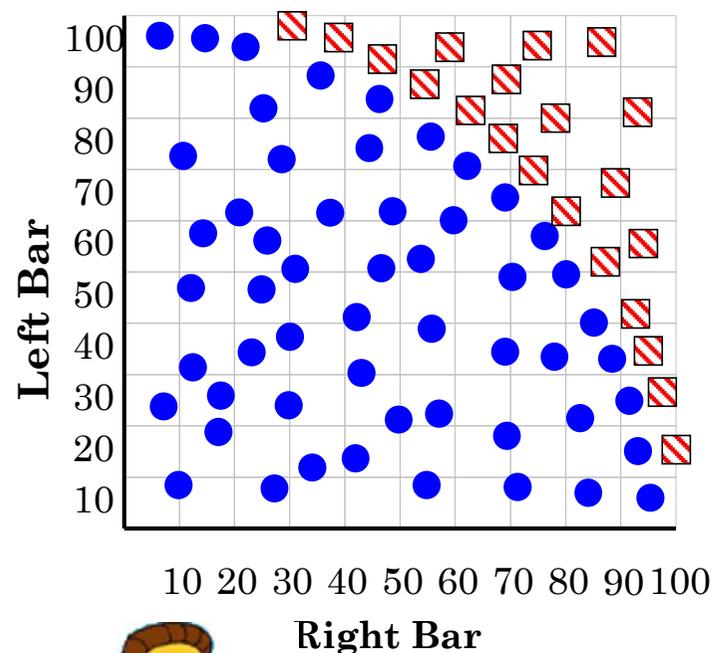
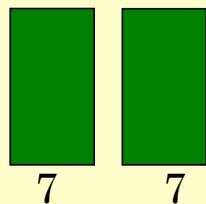
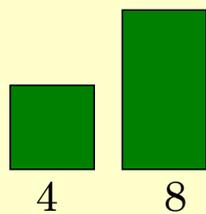
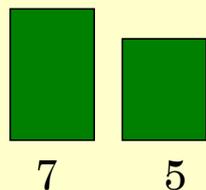
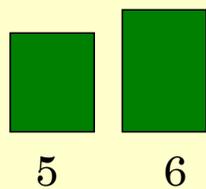


# Jogo #3

Exemplos da classe A



Exemplos da classe B



A regra é:  
 Se a soma do quadrado das  
 barras é menor ou igual a 100 é  
**A**. Caso contrário é **B**.

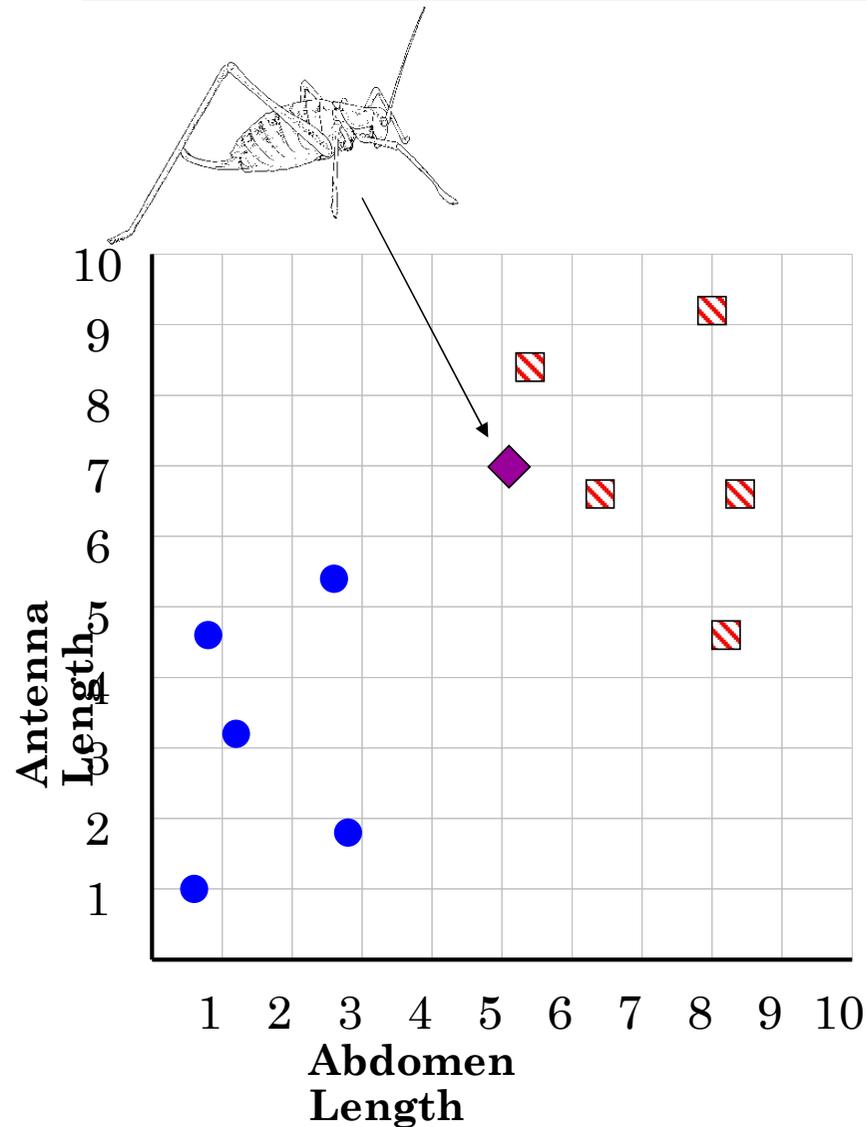
Inseto desconhecido →

11

5.1

7.0

???????



- Podemos projetar o inseto desconhecido no mesmo espaço dos demais dados do conjunto.

- Agora que abstraímos os detalhes, será mais fácil falar dos dados.

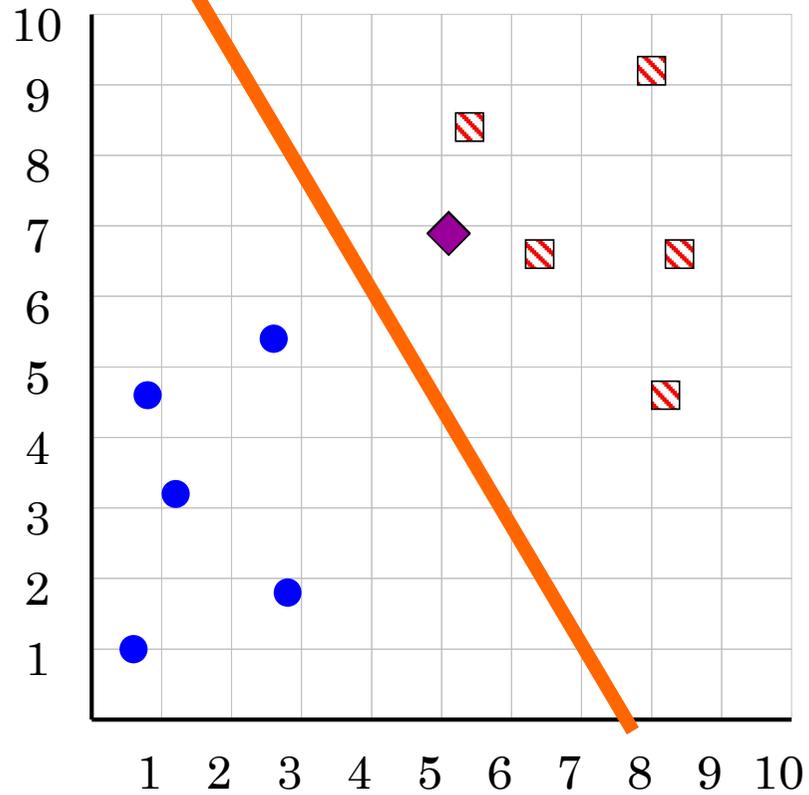
▣ Katydid

● Grasshoppers

# Classificador linear simples



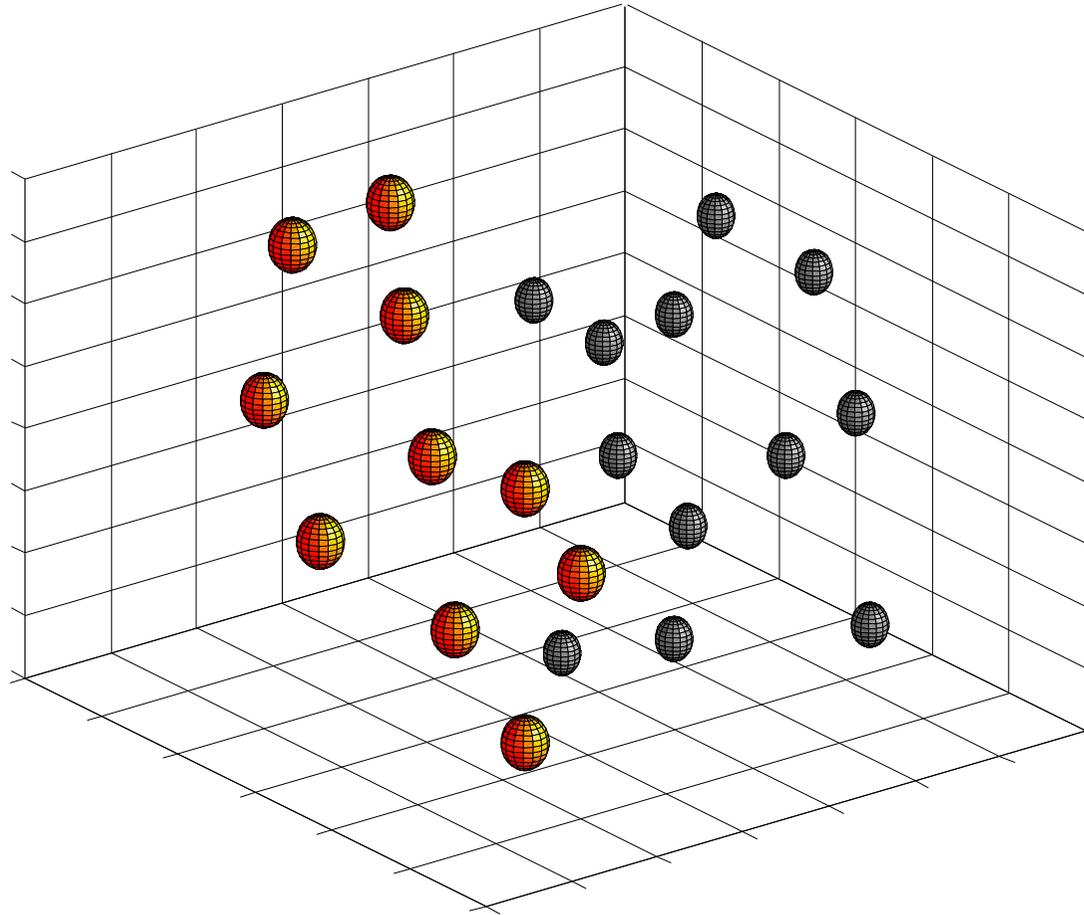
R.A. Fisher  
1890-1962



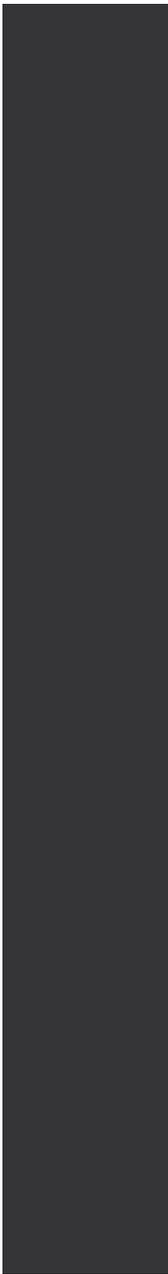
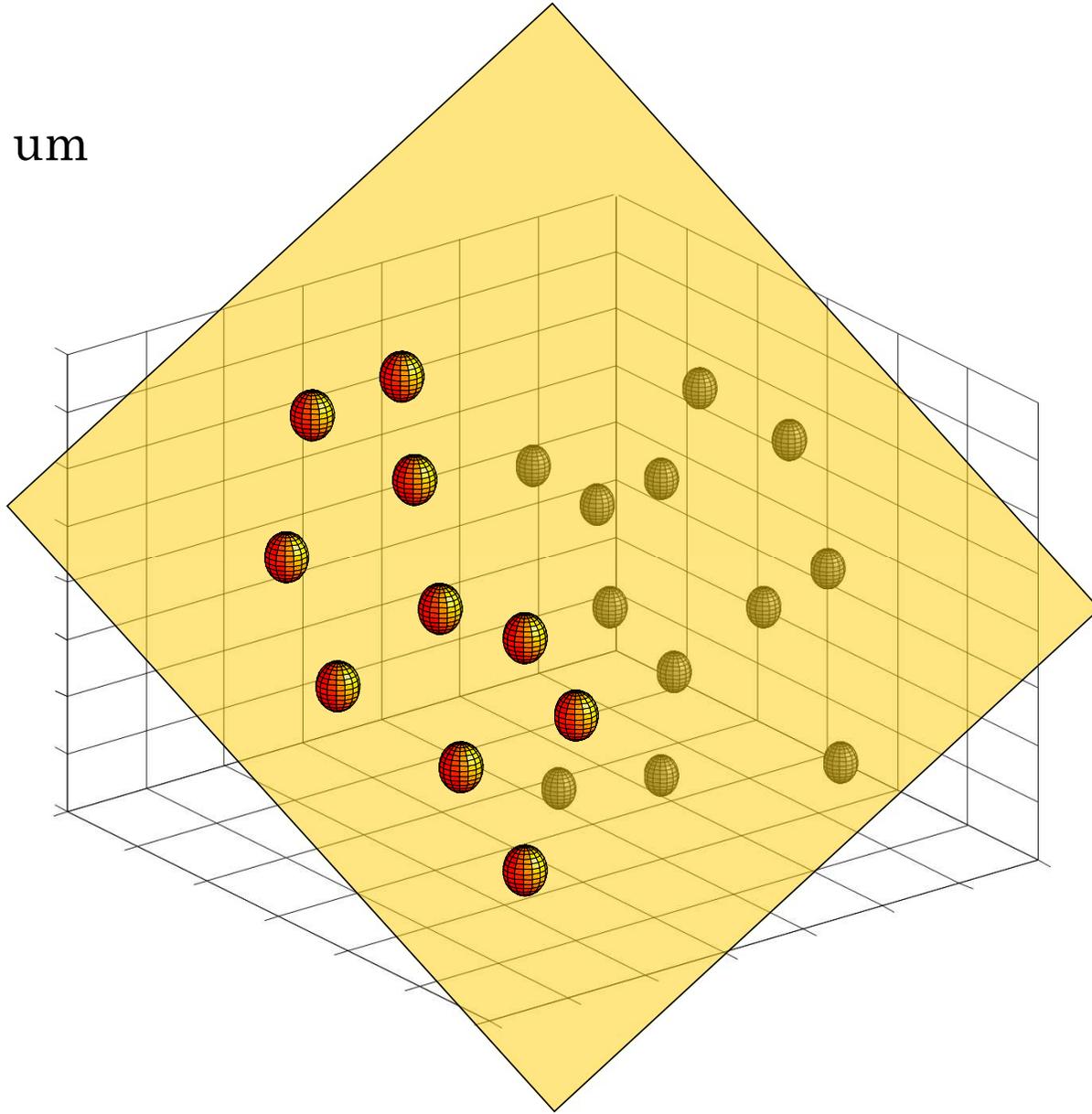
Se o atributo desconhecido  
está acima da linha  
então  
a classe é **Katydid**  
senão  
a classe é **Grasshopper**

▣ **Katydid**  
● **Grasshoppers**

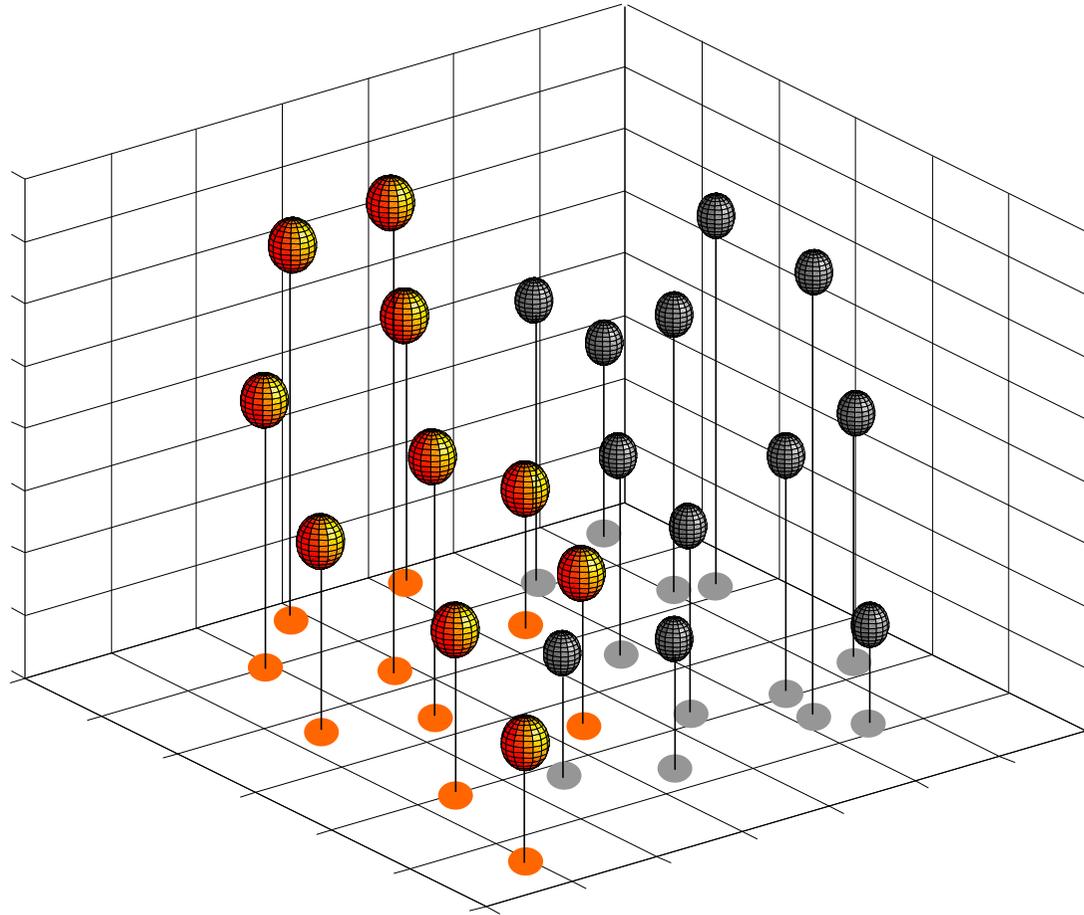
Esse mesmo tipo de classificador pode ser usado em mais espaços dimensionais...

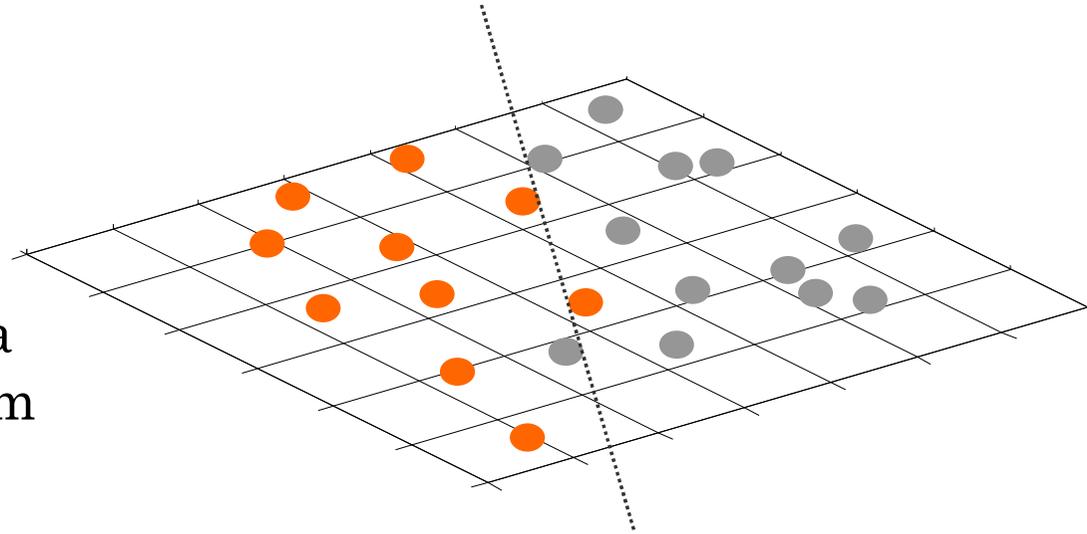


... Podemos  
visualizar como um  
n-dimensional  
hiperplano.



Podemos pensar  
o que aconteceria  
neste mesmo  
exemplo se não  
tivéssemos a  
Terceira  
dimensão...

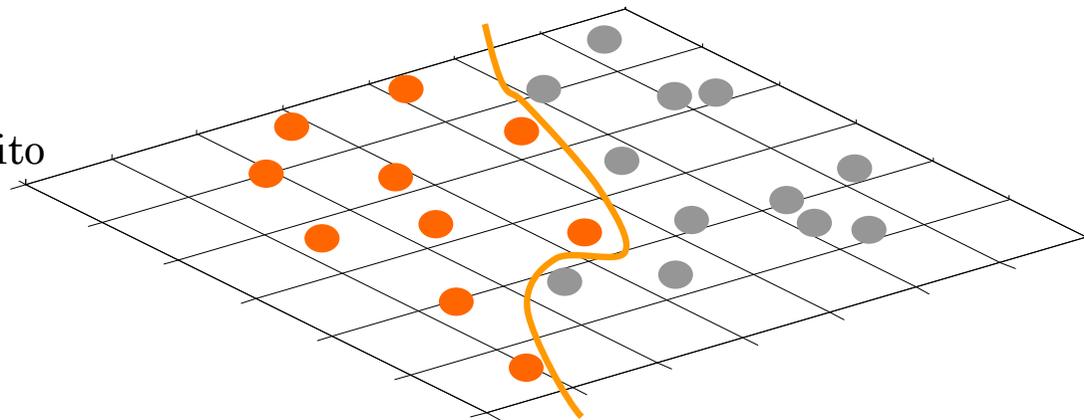




Já não podemos ter uma acurácia perfeita com um classificador linear...

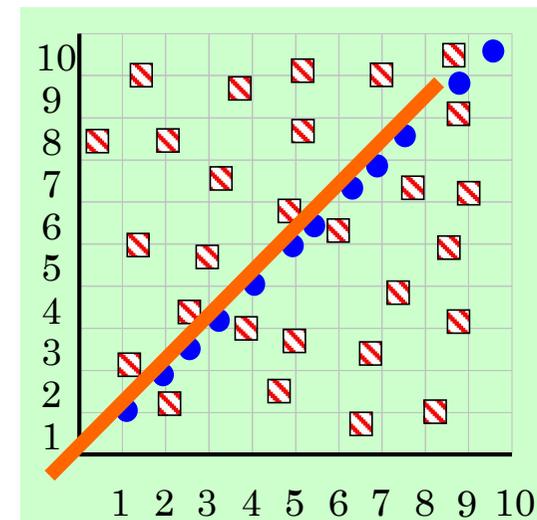
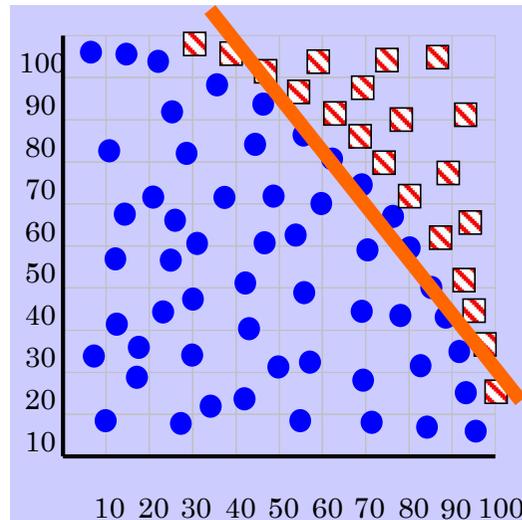
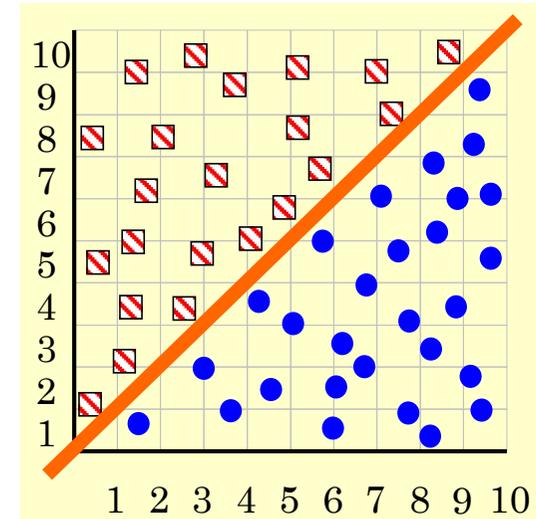
Poderíamos tentar solucionar esse problema com um classificador quadrático ou cúbico...

No entanto, não é uma ideia muito boa...



Quais dos #jogos podem ser resolvidos com um classificador linear simples?

- 1) Perfeito
- 2) Inútil
- 3) Muito bom



Problemas que podem ser resolvidos por um classificador linear são chamados de **Separáveis linearmente**.

# *Hands On!*

- Use `read.csv` para ler o arquivo “insetos00.csv”. Na sequência defina um modelo linear simples para classificar os insetos com as seguintes características como Grasshoper e katydid (respectivamente):

Abdômen= 3.2 e Antena=4.2

Abdômen= 7.2 e Antena=4.1

## *Tech help*

Use `abline(y, inclinacao)` para definir sua linha