

Máquinas Enxergam Desenhos Elétricos?

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2017







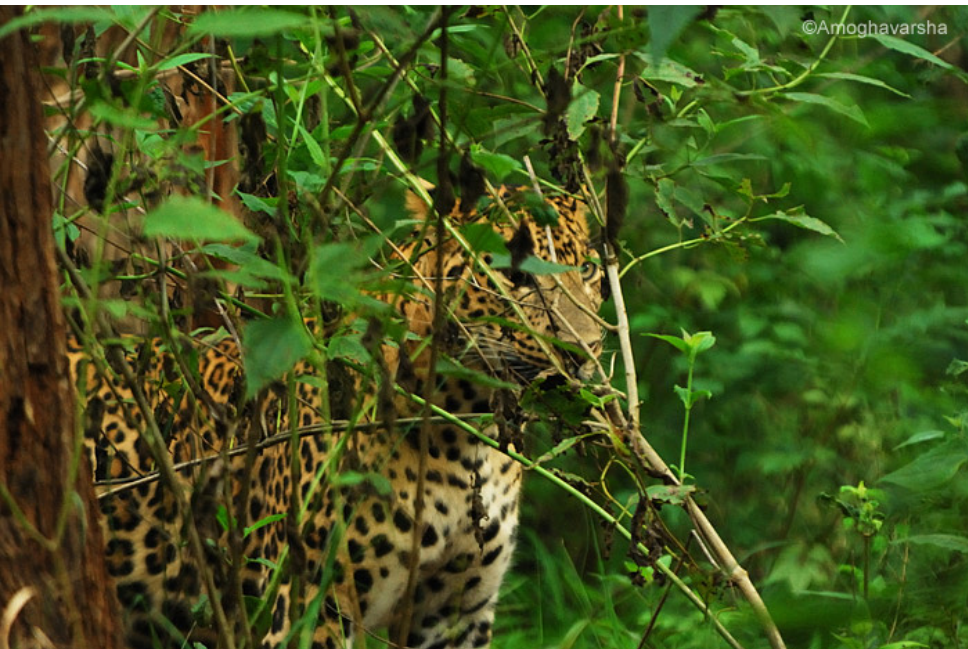






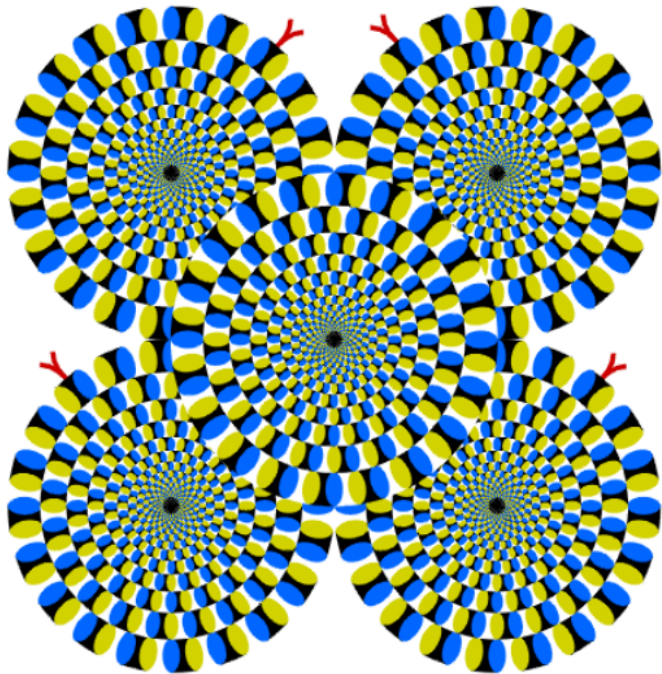


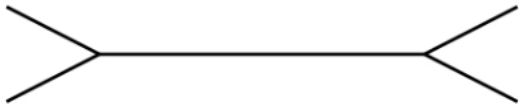
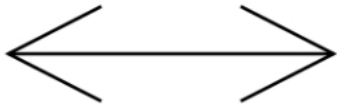




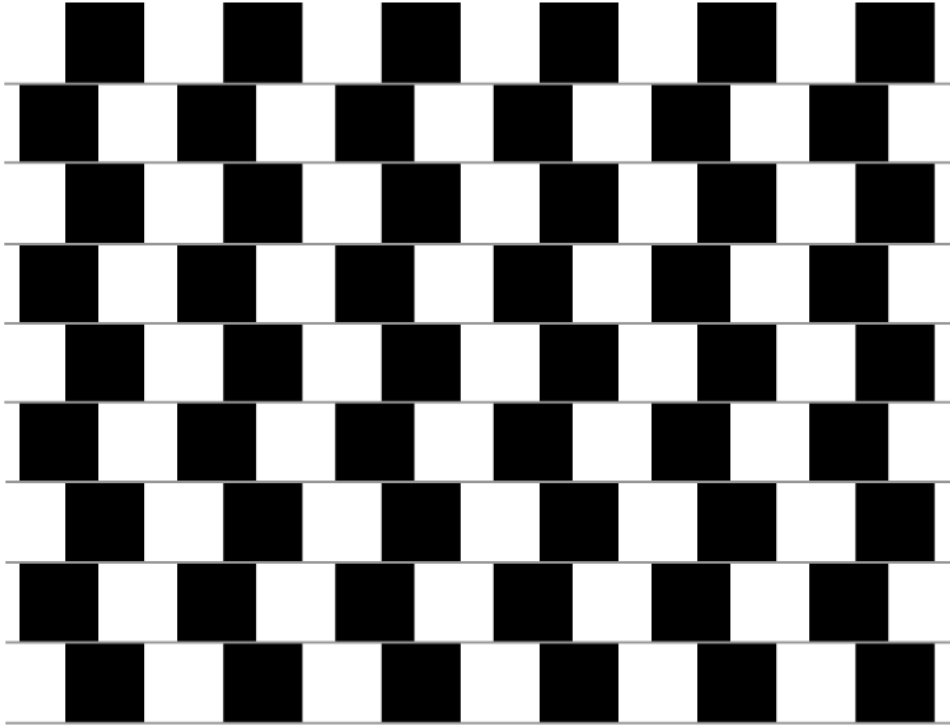


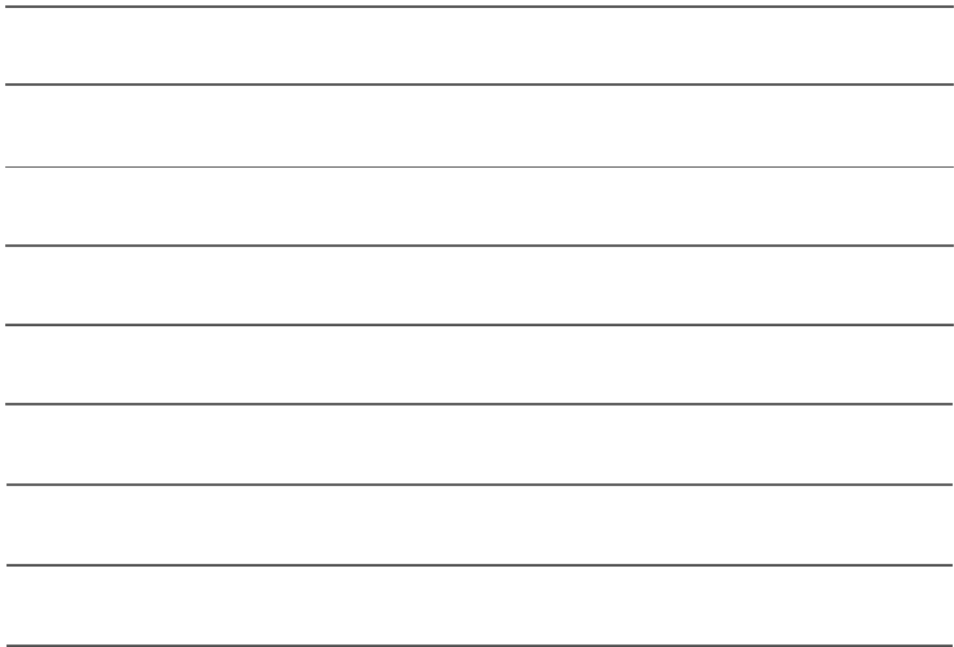




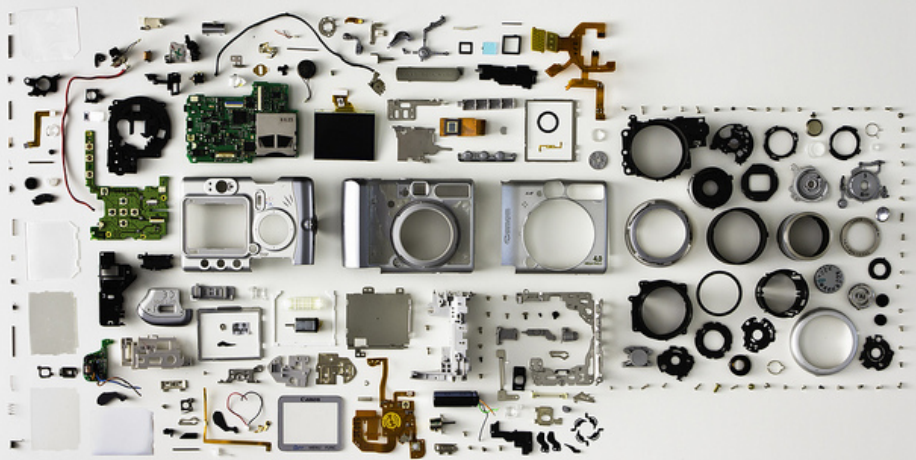












Processamento de Imagens

Computação Gráfica

Visão Computacional

Definições: processamento de imagens



Imagem

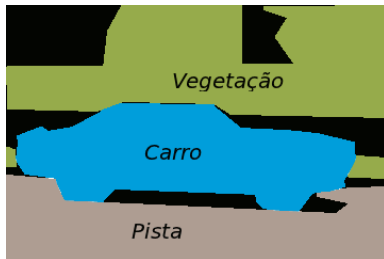


Imagem processada

Definições: visão computacional

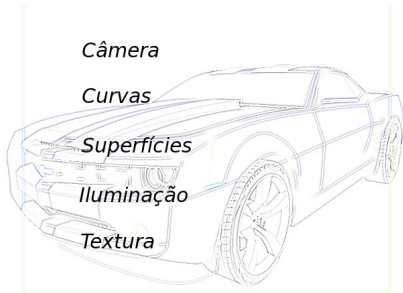


Imagem

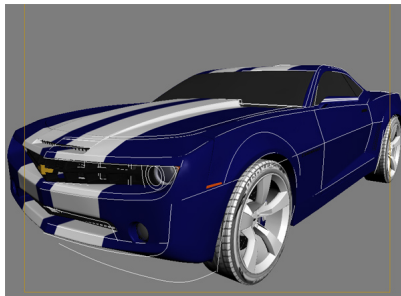


Dados e Modelos

Definições: computação gráfica



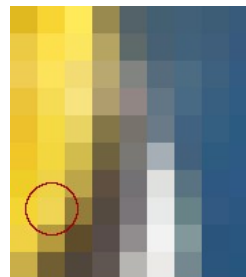
Dados e Modelos



Imagem

Visão humana e computacional

- Humanos: cor + estrutura espacial + memória
- Computador: arranjo de valores



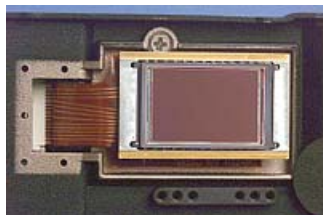
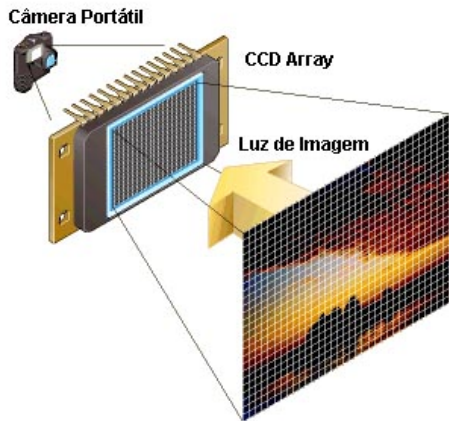
[253, 213, 51]

Imagem

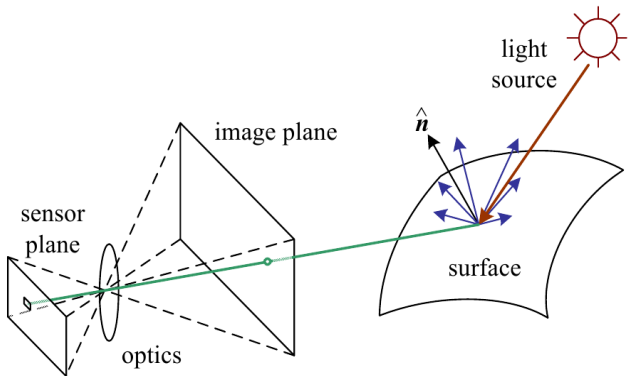
- Função bidimensional (2-d) de intensidade de luz $f(x, y)$:
 - x e y são as coordenadas espaciais
 - f no ponto (x, y) representa a intensidade ou cor naquela coordenada
 - na prática, são definidas em regiões retangulares
- Contínua no espaço
- Contínua em amplitude



Aquisição



Formação da imagem



Pipeline de geração de imagem digital

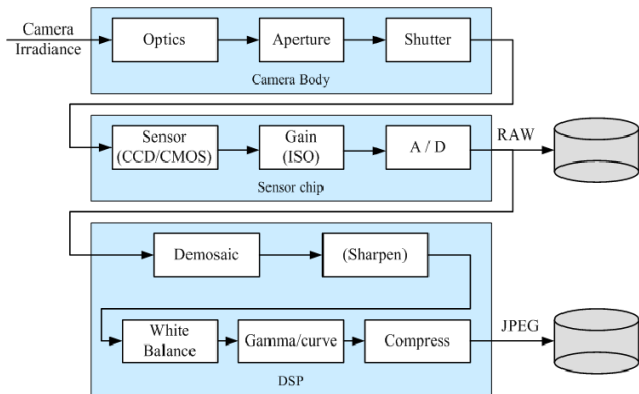
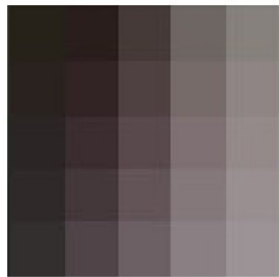
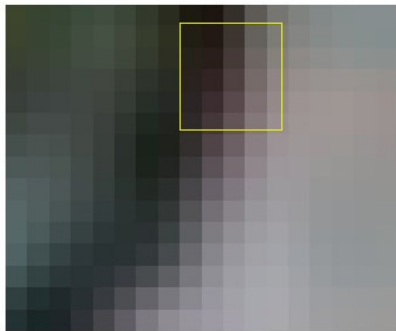
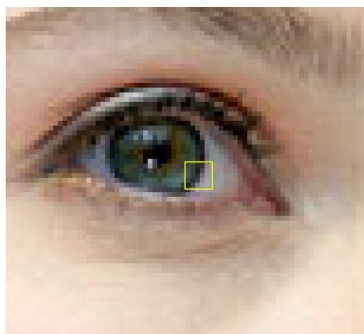
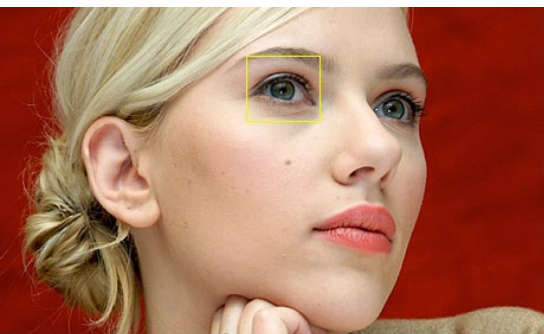
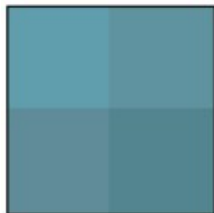


Imagem Digital

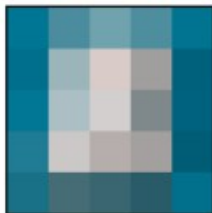
- Ao adquirir a imagem a função contínua é **amostrada** e sua amplitude **quantizada**.
- Como resultado, a **imagem digital** é a representação da imagem contínua por um *array 2-d de amostras discretas*.
- Cada elemento da matriz é chamado de **pixel**.



2 x 2



5 x 5



10 x 10



20 x 20



50 x 50

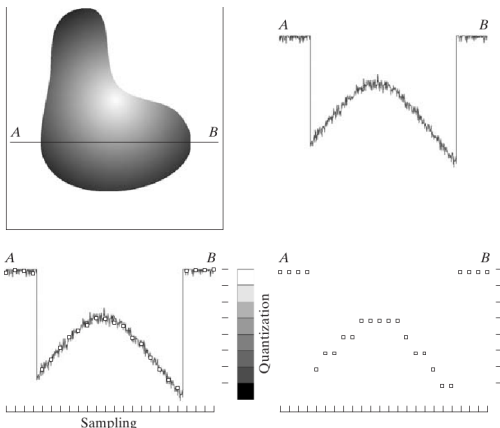


100 x 100

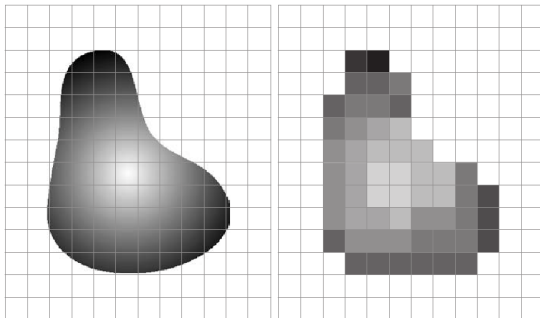


Número de cores: quantização

- Após amostrar a imagem o sensor ainda precisa converter cada observação “real” em uma observação discreta, definida pelo número de bits usados para armazená-lo.



Número de cores: quantização





Componentes de cor



Vermelho (R)



Verde (G)



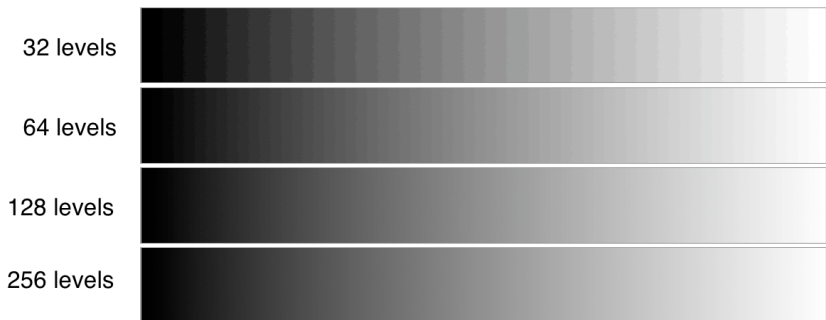
Azul (B)



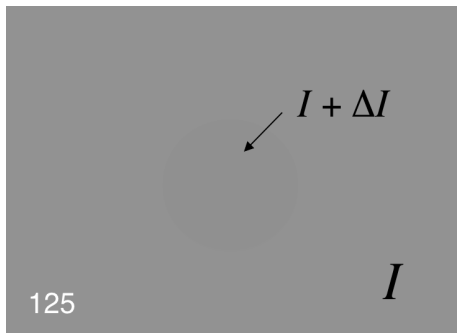
24 bits (8 + 8 + 8)

Níveis de cinza

Ao visualizar em sequência os níveis de cinza utilizando quantização diferente, é possível ver falsos contornos gerados:



Níveis de cinza: discernimento de brilho



- O limiar de visibilidade foi determinado experimentalmente por Weber:

$$\Delta I / I \approx K_{\text{Weber}} \approx 1.2\%,$$

chamada: fração de Weber ou lei de Weber.

Número de cores: quantização



Imagem binária (0-1)

Número de cores: quantização



(Domício Pinheiro / Agência Estado)

Imagem binária (0-1)





HKS
K

HKS
K
HKS
K

HKS 1
Hostmann-Staerck

HKS 10
Hostmann-Staerck

HKS 12
Hostmann-Staerck

HKS 3
Hostmann-Staerck

HKS 4
Hostmann-Staerck

HKS 5
Hostmann-Staerck

HKS 6
Hostmann-Staerck

HKS 7
Hostmann-Staerck

HKS 8
Hostmann-Staerck

HKS 10 K
Hostmann-Staerck

HKS 12 K
Hostmann-Staerck

HKS 3 K
Hostmann-Staerck

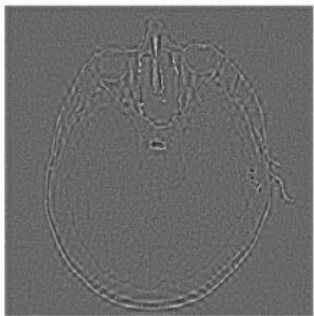
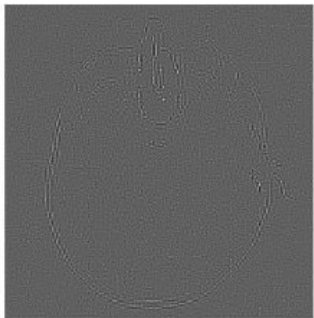
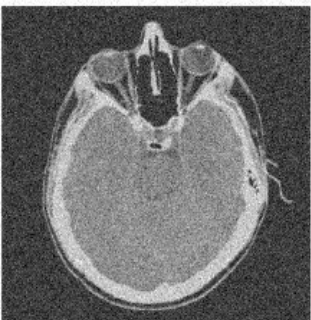
HKS 4 K
Hostmann-Staerck

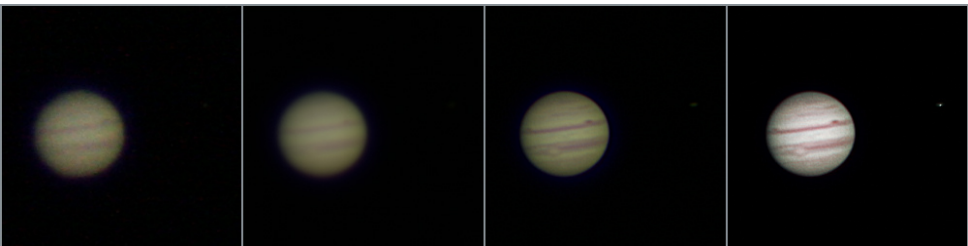
HKS 5 K
Hostmann-Staerck

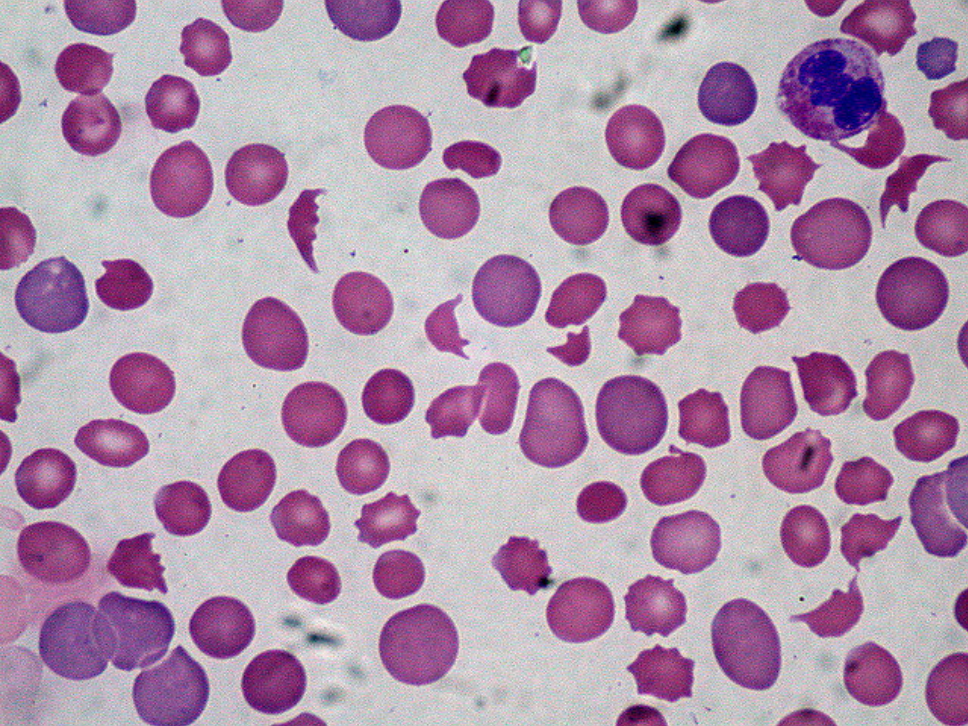
HKS 6 K
Hostmann-Staerck

HKS 7 K
Hostmann-Staerck

HKS 8 K
Hostmann-Staerck











OREGON
6-17412

MOTOROLA
MSR





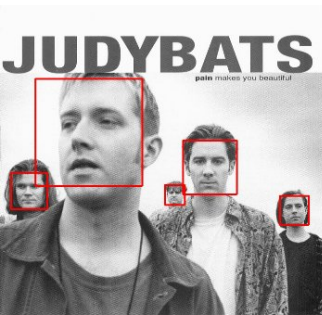


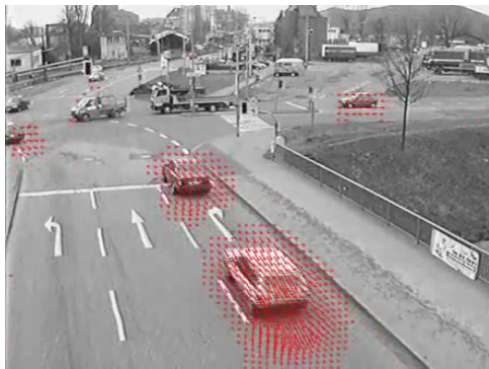
MSD
MOTOROLA
SUNOCO

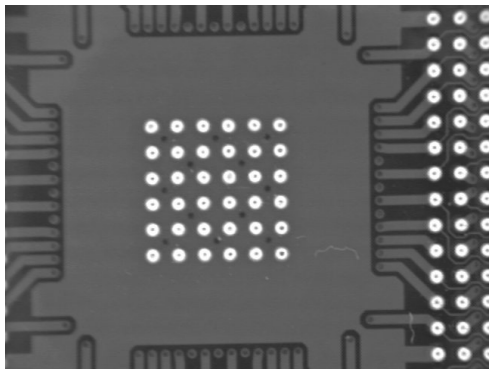
OREGON
FRATEL

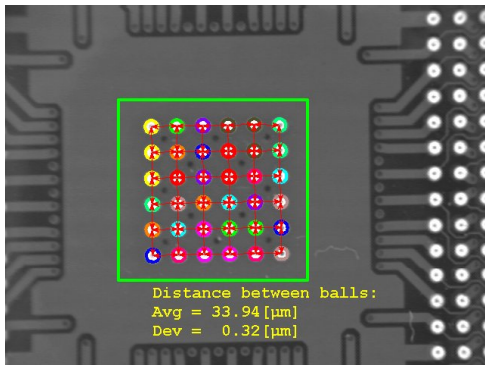
MSD
MOTOROLA
SUNOCO

MSD
MOTOROLA
SUNOCO

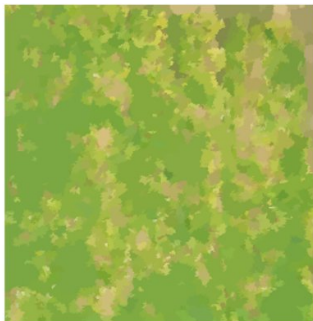




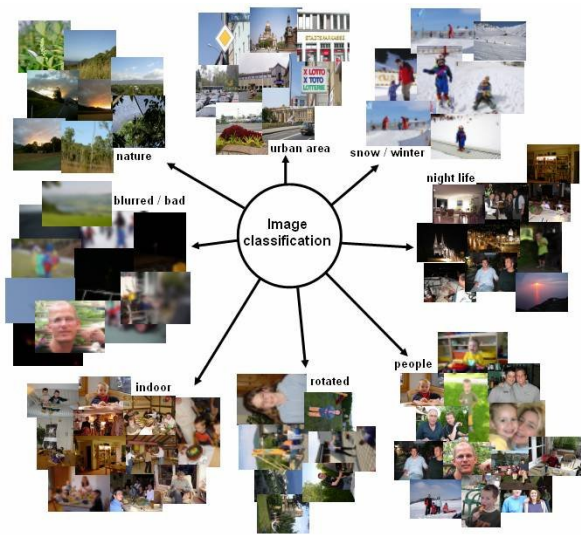












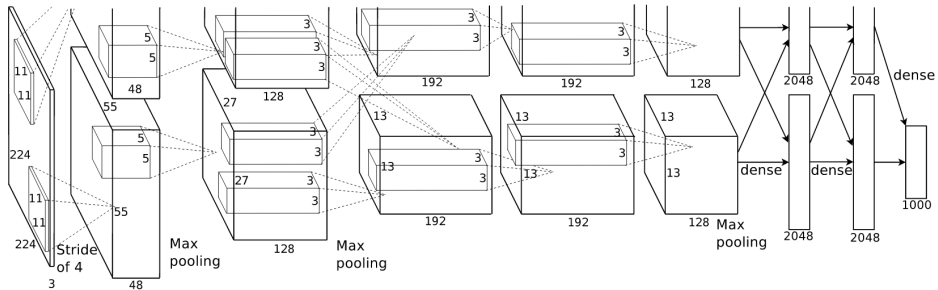


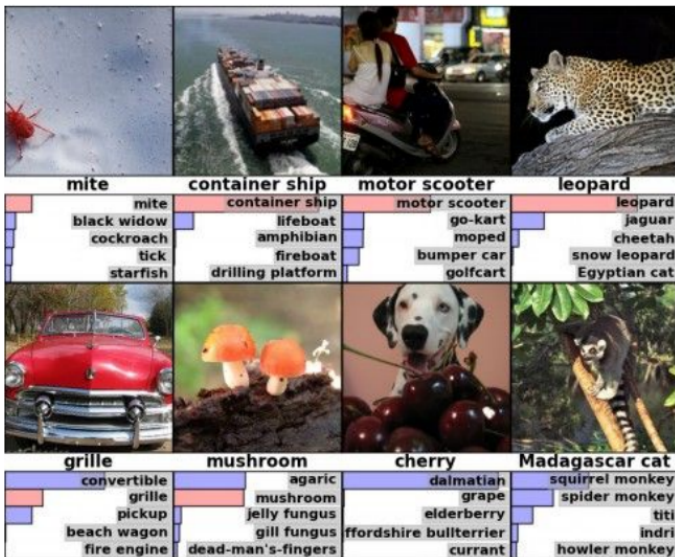
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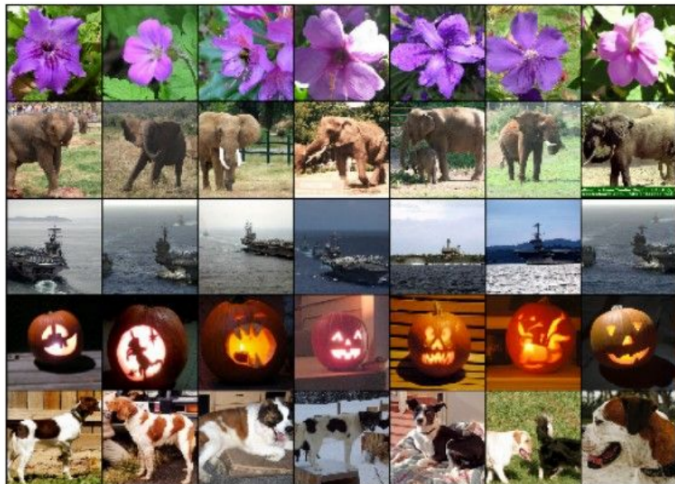
**OFFICIAL
REVIEW**

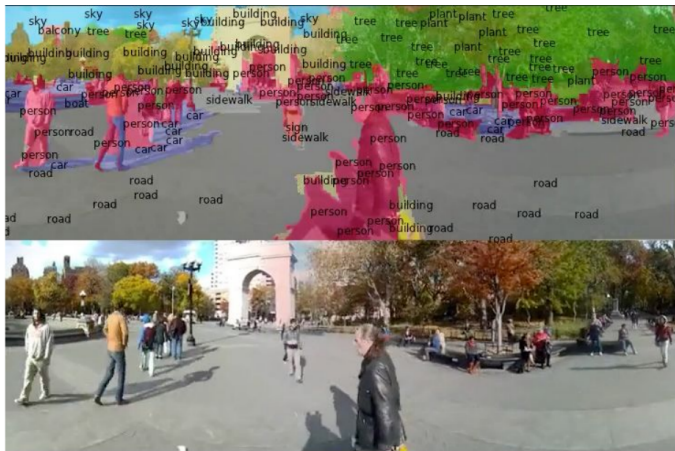


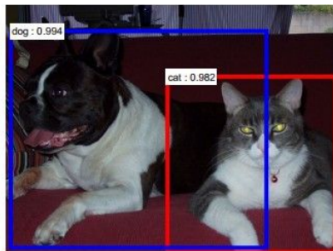
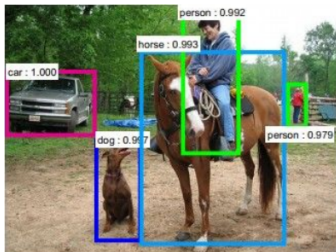












No errors



A white teddy bear sitting in the grass

Minor errors



A man in a baseball uniform throwing a ball

Somewhat related



A woman is holding a cat in her hand



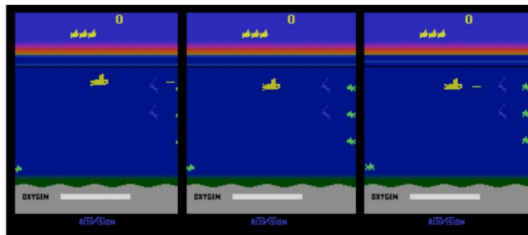
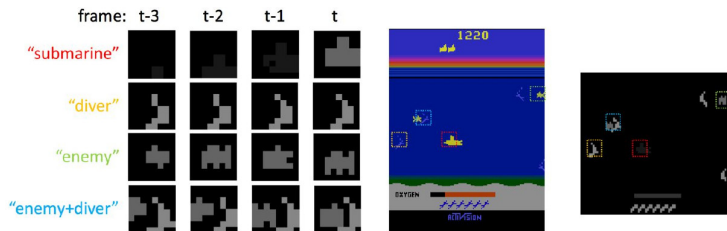
A man riding a wave on top of a surfboard



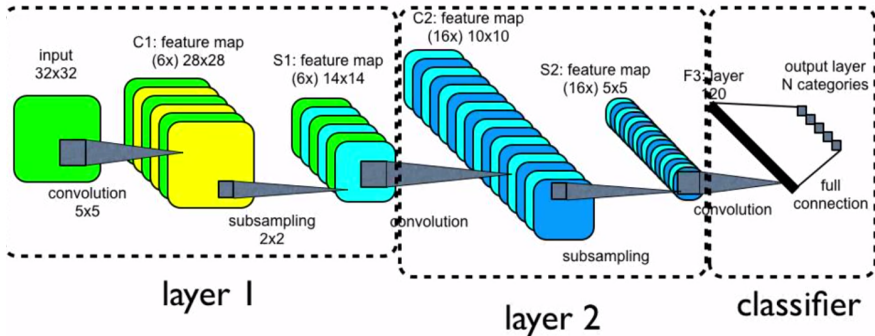
A cat sitting on a suitcase on the floor



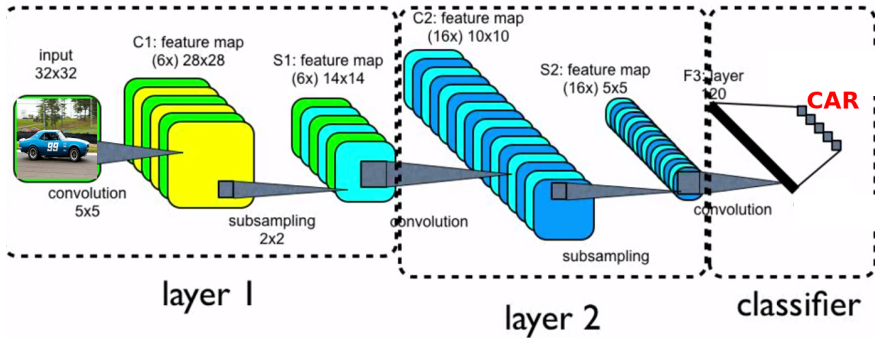
A woman standing on a beach holding a surfboard



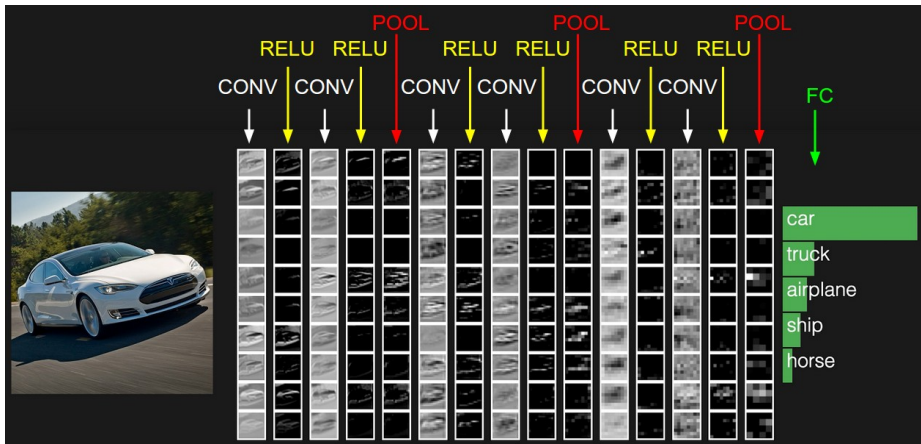
CNN == (Convolution-Activation-Pooling) + (Fully Connected/Multilayer Perceptron)



CNN == (Convolution-Activation-Pooling) + (Fully Connected/Multilayer Perceptron)



CNN == (Convolution-Activation-Pooling) + (Fully Connected/Multilayer Perceptron)



Parametrização otimizada via “backpropagation”

$$\frac{\partial \overset{\text{erro}}{\boxed{E_p}}}{\partial w_{i,j}} = \frac{\partial E_p}{\partial o_{p,j}} \frac{\partial \overset{\text{saída}}{\boxed{o_{p,j}}}}{\partial w_{j,i}}$$

Minimização do Erro

Uso da inclinação da função objetivo no espaço de parâmetros

$$\frac{df(x)}{dx} = \lim_{\delta \rightarrow 0} \frac{f(x + \delta) - f(x)}{\delta}$$

Para cada parâmetro j e exemplo i

$$\frac{d\ell(f(w_j, \mathbf{x}_i))}{dw_j} = \lim_{\delta \rightarrow 0} \frac{f(w_j + \delta, \mathbf{x}_i) - f(w_j, \mathbf{x}_i)}{\delta}$$

Temos múltiplas dimensões e portanto um gradiente

Gradient descent — algoritmo que busca pelo vale da função, movendo na direção oposta ao gradiente.

Fundamentação Teórica

- Cálculo
 - Álgebra Linear
 - Probabilidade
 - Otimização
-
- Ampla variedade de aplicações
 - Métodos tem utilizado aprendizado
 - Técnicas clássicas tem espaço e relevância em especial devido ao entendimento dos resultados

VICG: Visualização, Imagens e Computação Gráfica

- Moacir Ponti
- João E.S. Batista Neto
- Maria Cristina Oliveira
- Rosane Minghim

Outros pesquisadores em áreas correlatas

- Agma Traina (Grupo de Bases de dados e imagens)
- Rudinei Goularte (Intermídia)
- Denis Wolf e Fernando Osório (Laboratório de Robótica Móvel)

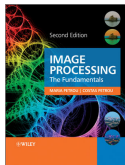
Disciplinas da área e correlatas

- scc0250 — Computação Gráfica
- scc0251 — Processamento de Imagens
- scc0252 — Visualização Computacional

-  GONZALEZ, R.C.; WOODS, R.E. **Processamento Digital de Imagens**, 3.ed
Pearson, 2010.



-  PETROU, M. **Image Processing: the fundamentals**, 2.ed
Wiley, 2010.



Bibliografia II

-  **JAIN, A.K. The fundamentals of Digital Image Processing**
Prentice-Hall, 1988.






-  **SZELISKI, R. Computer Vision: algorithms and applications**
Springer, 2011.

http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf



Bibliografia III

-  OpenCV (Open Source Computer Vision)
<http://docs.opencv.org>.
-  GNU Octave
<http://www.gnu.org/software/octave/>
-  R (GNU S)
<http://www.r-project.org>