



UNIVERSITY OF  
**OXFORD**

# **Taxonomy of Computer Vision: Hilbert Problems for Vision**

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# Computer Vision ...

...extracting information from images and videos



- What is in the image ?
    - object categorization
    - object shape
    - materials
  - Where is it ?
    - 3D spatial layout
  - How is the camera moving ?
  - What is the action ?
- 
- human visual abilities has long been our aspiration and inspiration.
  - use human as existence proof that certain tasks can be done visually,

# Computer Vision ...

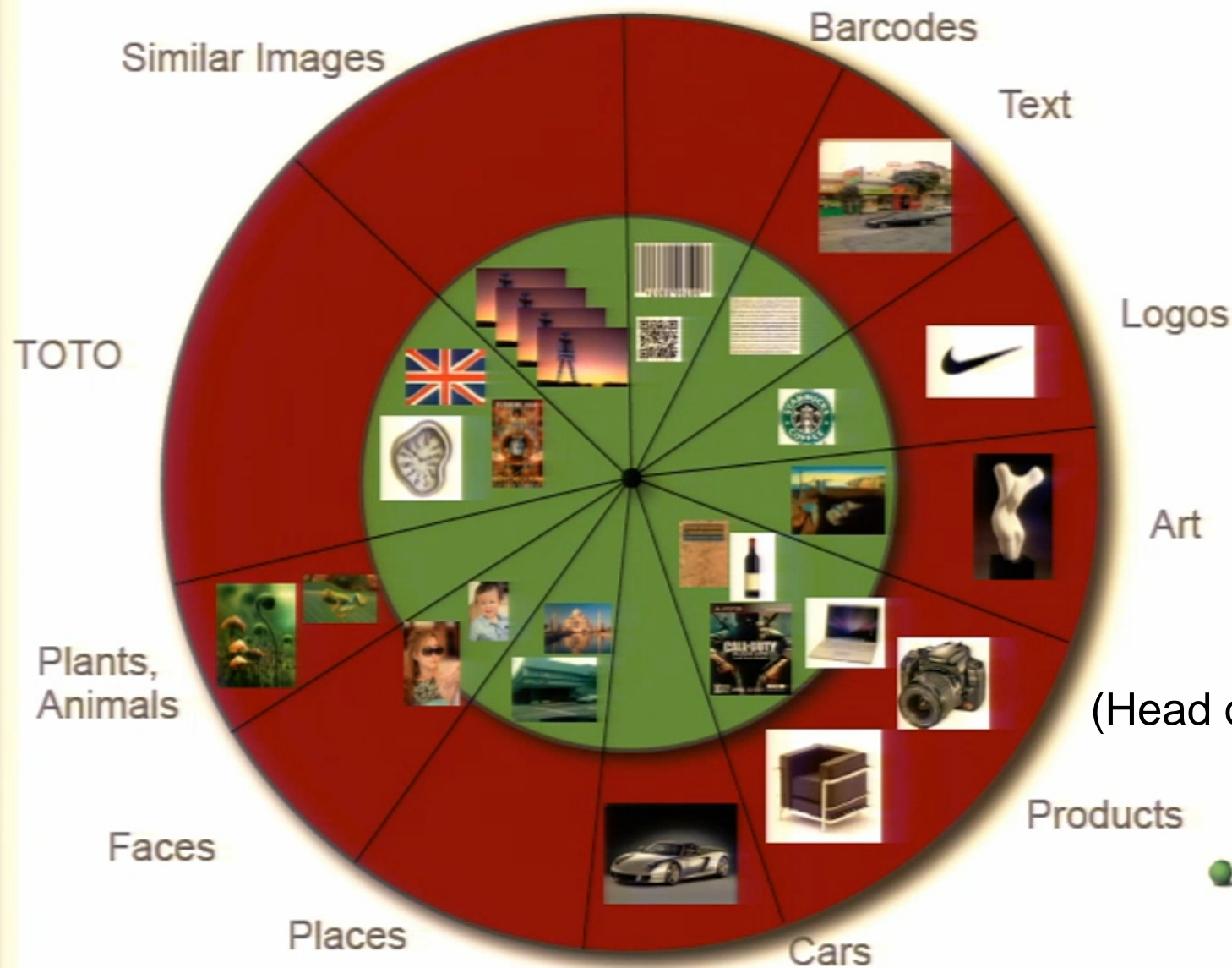
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# What can we not do now that we would like to be able to do?

Recognition disciplines that work and do not work



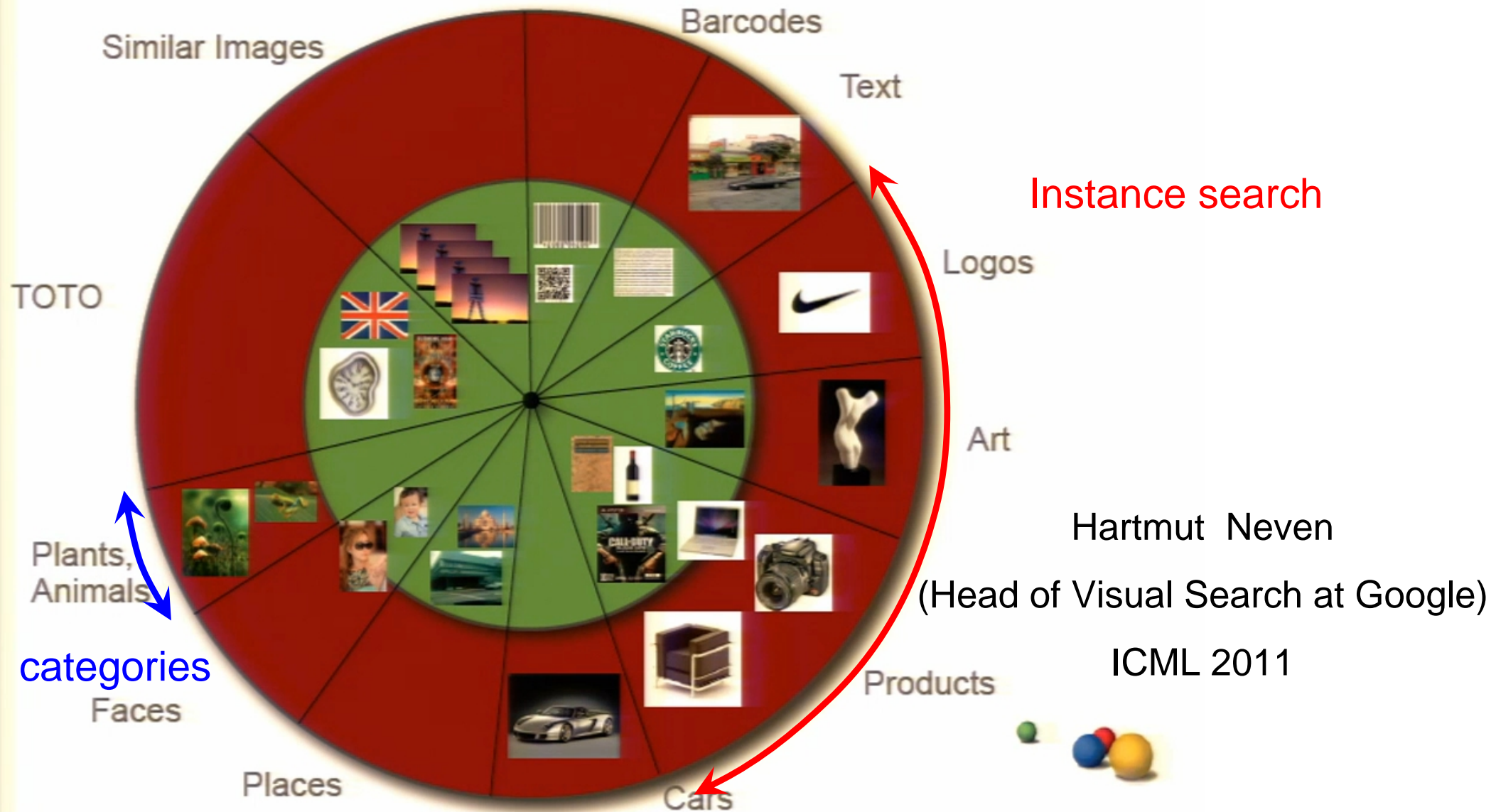
Hartmut Neven  
(Head of Visual Search at Google)

ICML 2011

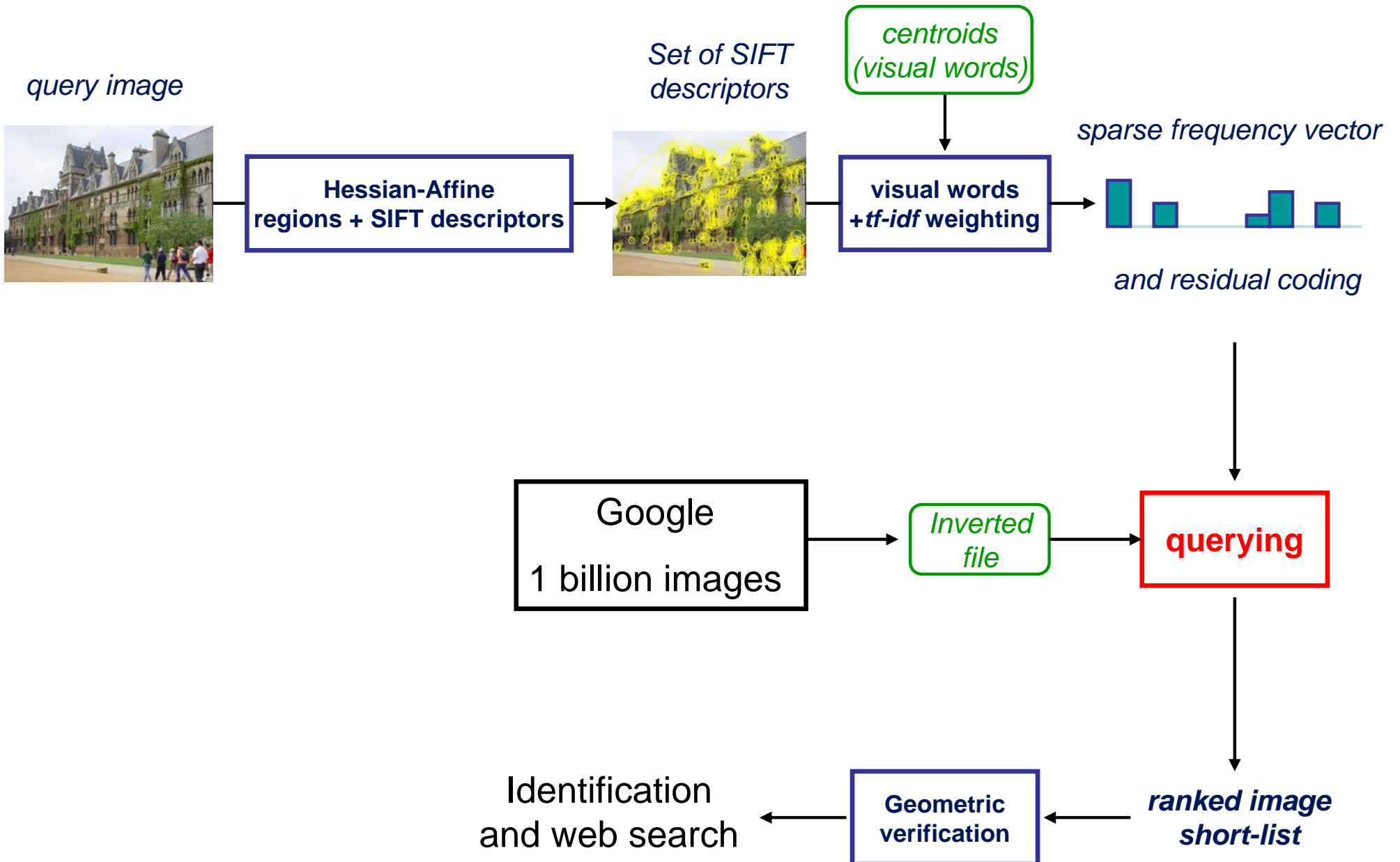


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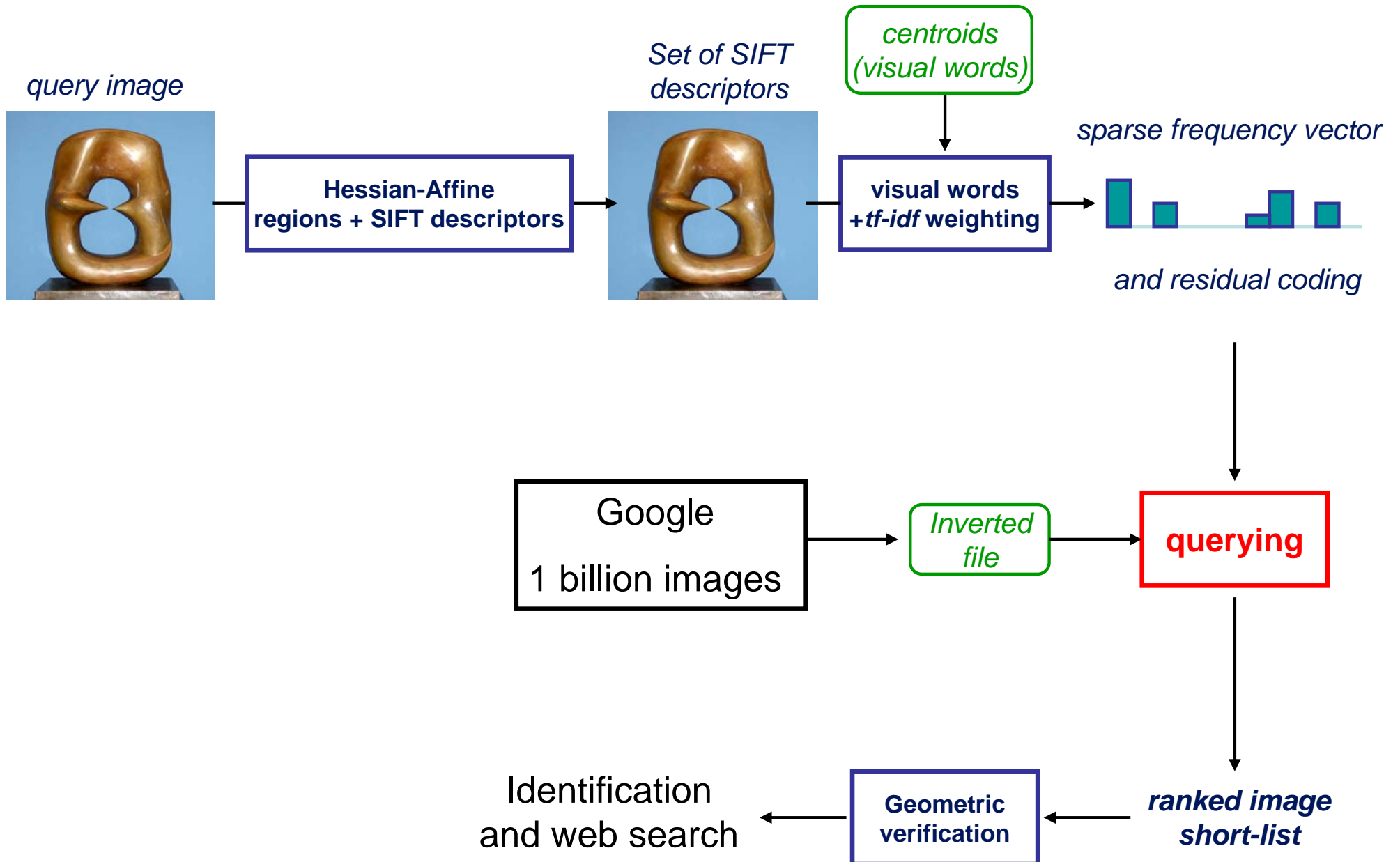
Recognition disciplines that work and do not work



# Instance search for weakly textured objects



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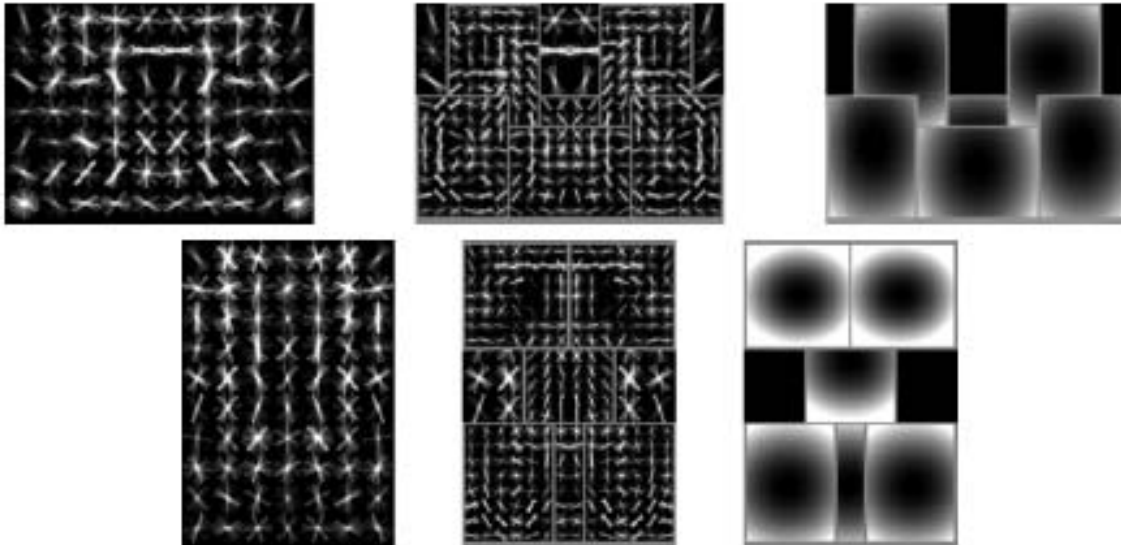
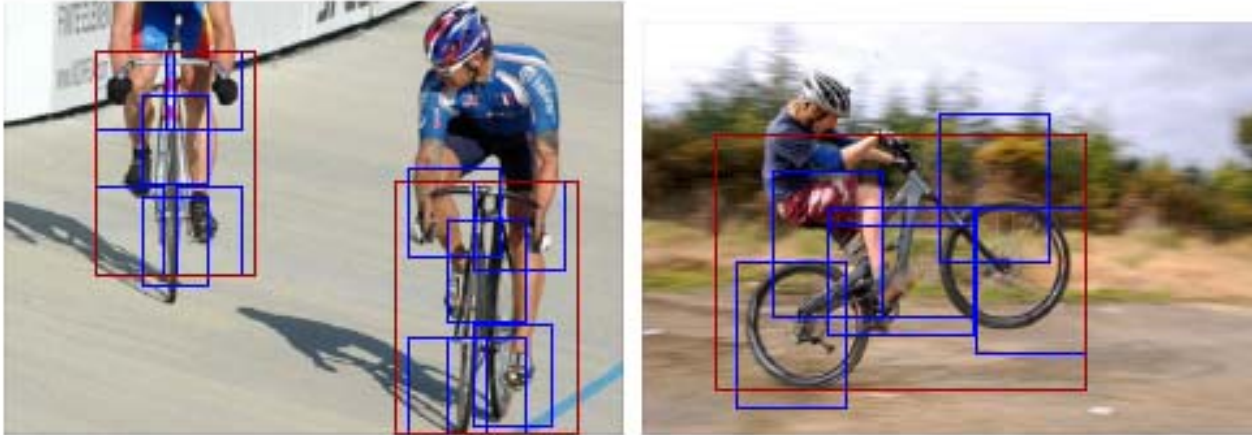
# The problem of instance recognition for untextured smooth objects



# The problem of instance recognition for wiry objects



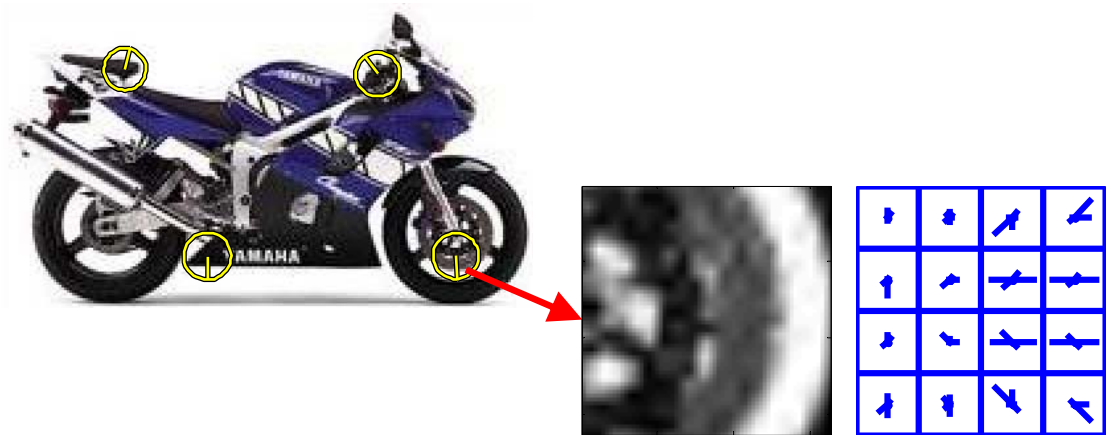
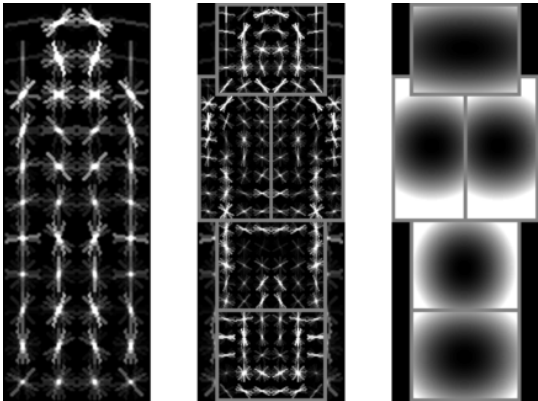
# Object category recognition



3D shape encoded implicitly by multiple aspects (components)

# What is represented?

- Local gradient fields (texture)
- Some geometry/spatial configurations



- Not material properties
- Not 3D shape

# Material recognition

Some resurgence of interest recently:

- datasets
- attributes



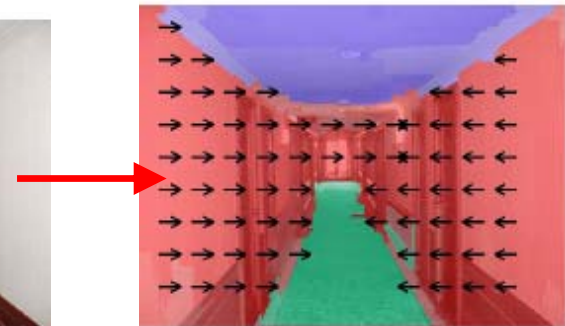
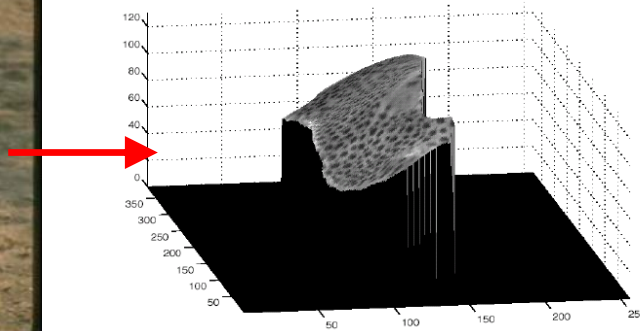
**Exploring Features in a Bayesian Framework for Material Recognition,**  
C. Liu, L. Sharan, E. H. Adelson and  
R. Rosenholtz, CVPR 2010

# 3D shape recovery

- Mathematics of surfaces (differential geometry) well understood

Some recent work:

- 3D Representation for Recognition workshops, ICCV'07, 09 & 11
- shape from texture work of Forsyth, IJCV'06
- scene recovery work of Hoiem, Efros and Hebert, 2005+

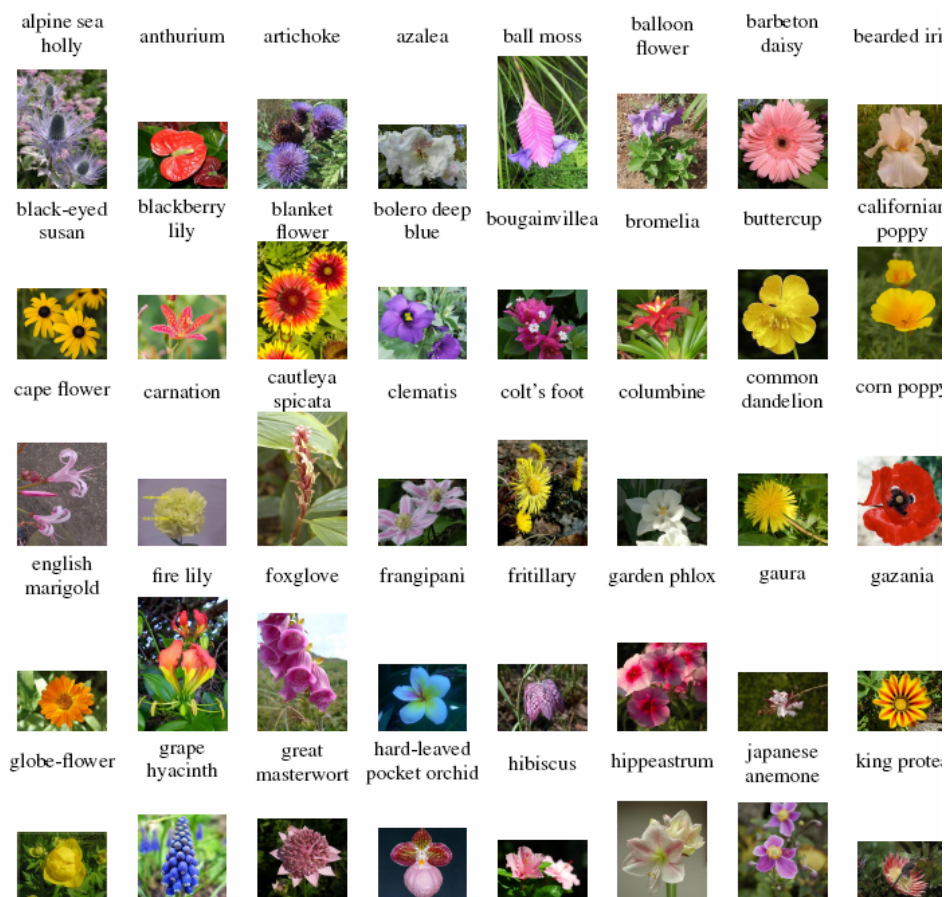


# Mini-Hilbert problems

- Visual representations to enable instance and category recognition for untextured smooth objects and wiry objects
- Object recognition informed by 3D shape
- Object recognition informed by material properties

# Fine grained visual categorization

## The Oxford Flowers 102



## Caltech-UCSD birds 200



# What is this?



Found throughout southern Africa, aardvarks use their keen sense of smell to sniff out their favorite food—termites.

*Photograph by Beverly Joubert*

- Move beyond supervised classification
- Attribute story ...