



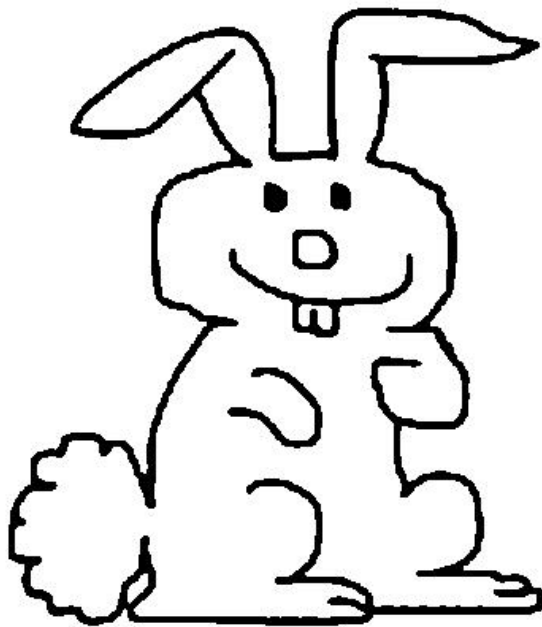
The Drawing Assistant

Automated Drawing Guidance and Feedback from Photographs

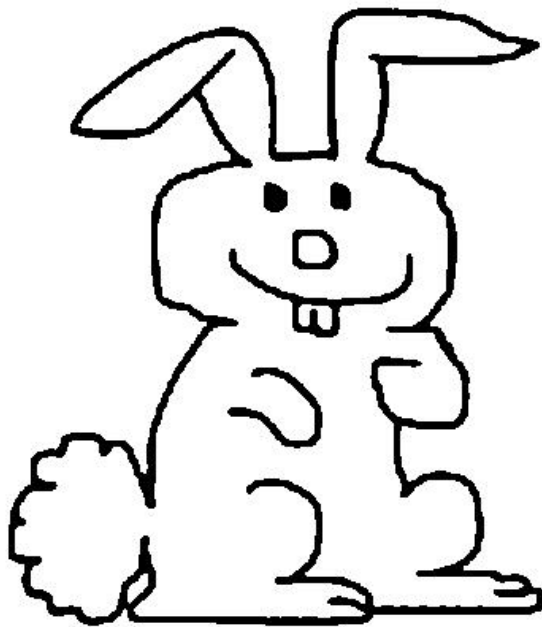
Emmanuel Iarussi
INRIA - Reves

Adrien Bousseau
INRIA - Reves

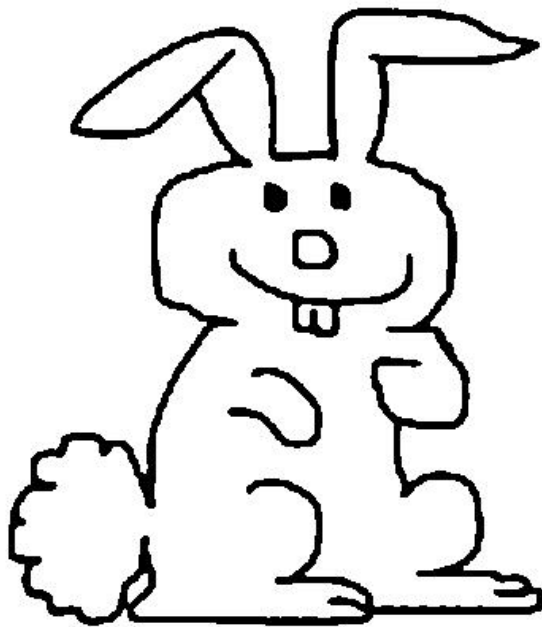
Theophanis Tsandilas
INRIA & Univ. Paris-Sud



How Do Humans Sketch Objects?
[Eitz et al. 2012]



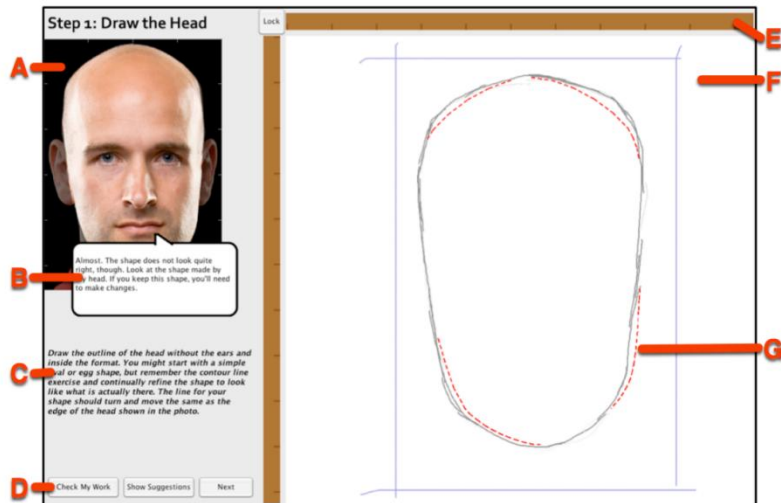
How Do Humans Sketch Objects?
[Eitz et al. 2012]



How Do Humans Sketch Objects?
[Eitz et al. 2012]

“Drawing from observation is to trust what we see rather than what we *know*”. [Dodson 1985]

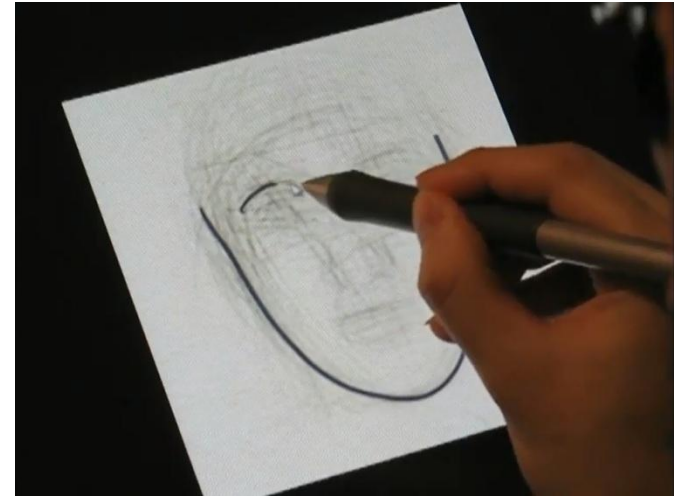
Tutorial



ICanDraw
[Dixon et al. 2010]

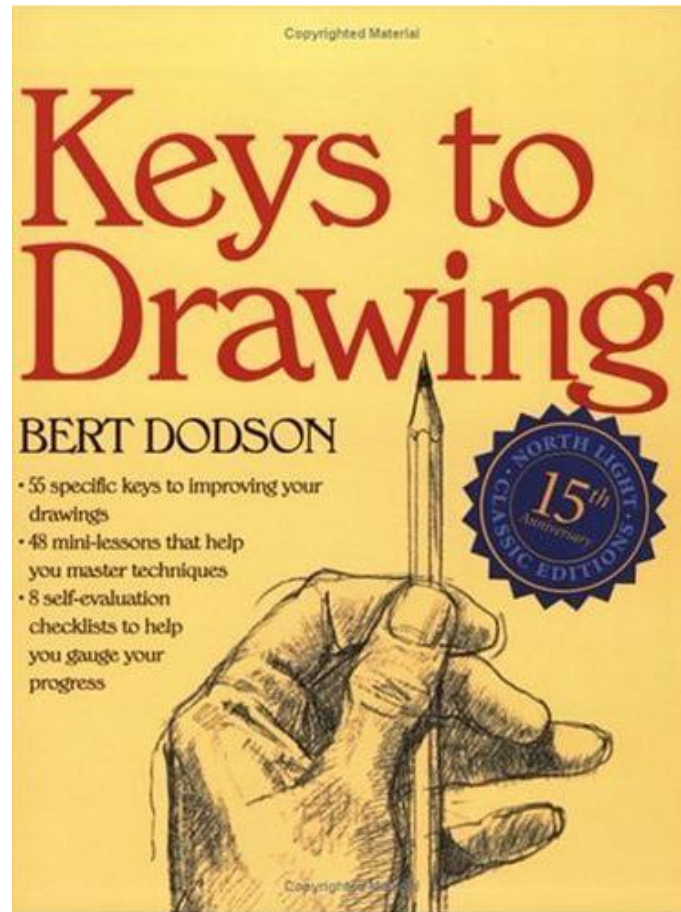
- Prerecorded examples

Tracing

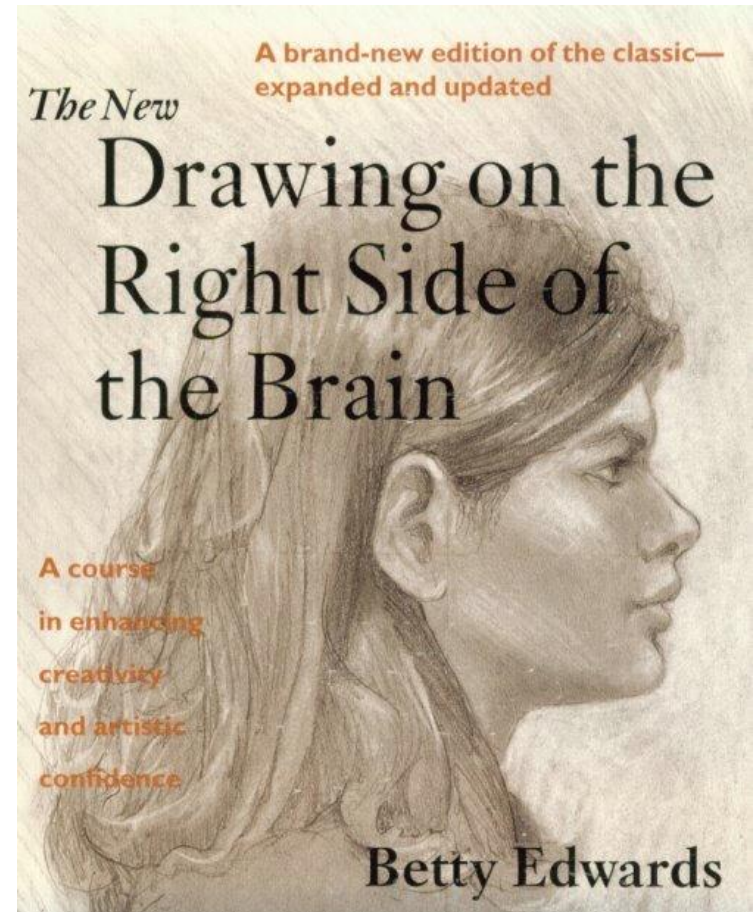


Shadowdraw
[Lee et al. 2011]

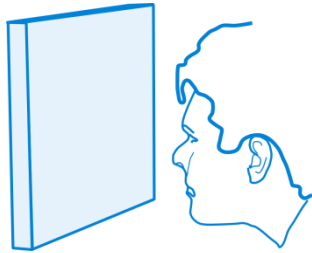
- Reminiscent of “connect the dots” drawing books
- Do not help to observe



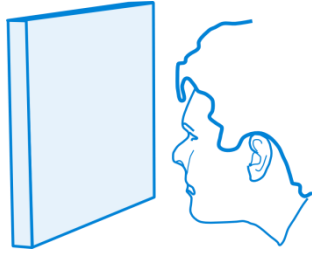
Keys to Drawing
[Dodson 1985]



Drawing on the Right Side of the Brain
[Edwards 1979]



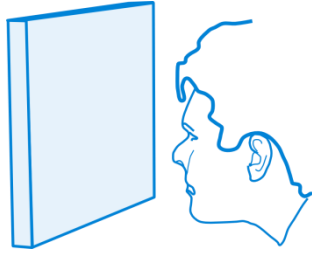
Encourage users to focus their attention on the actual model rather than their drawing.



Encourage users to focus their attention on the actual model rather than their drawing.



Help users to practice observational techniques proposed by the drawing literature.



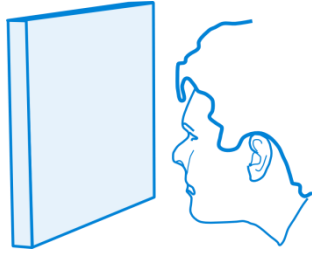
Encourage users to focus their attention on the actual model rather than their drawing.



Help users to practice observational techniques proposed by the drawing literature.



Support corrective feedback to help users understand their errors and refine their drawings.



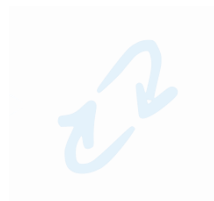
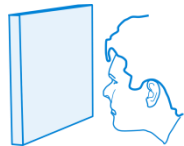
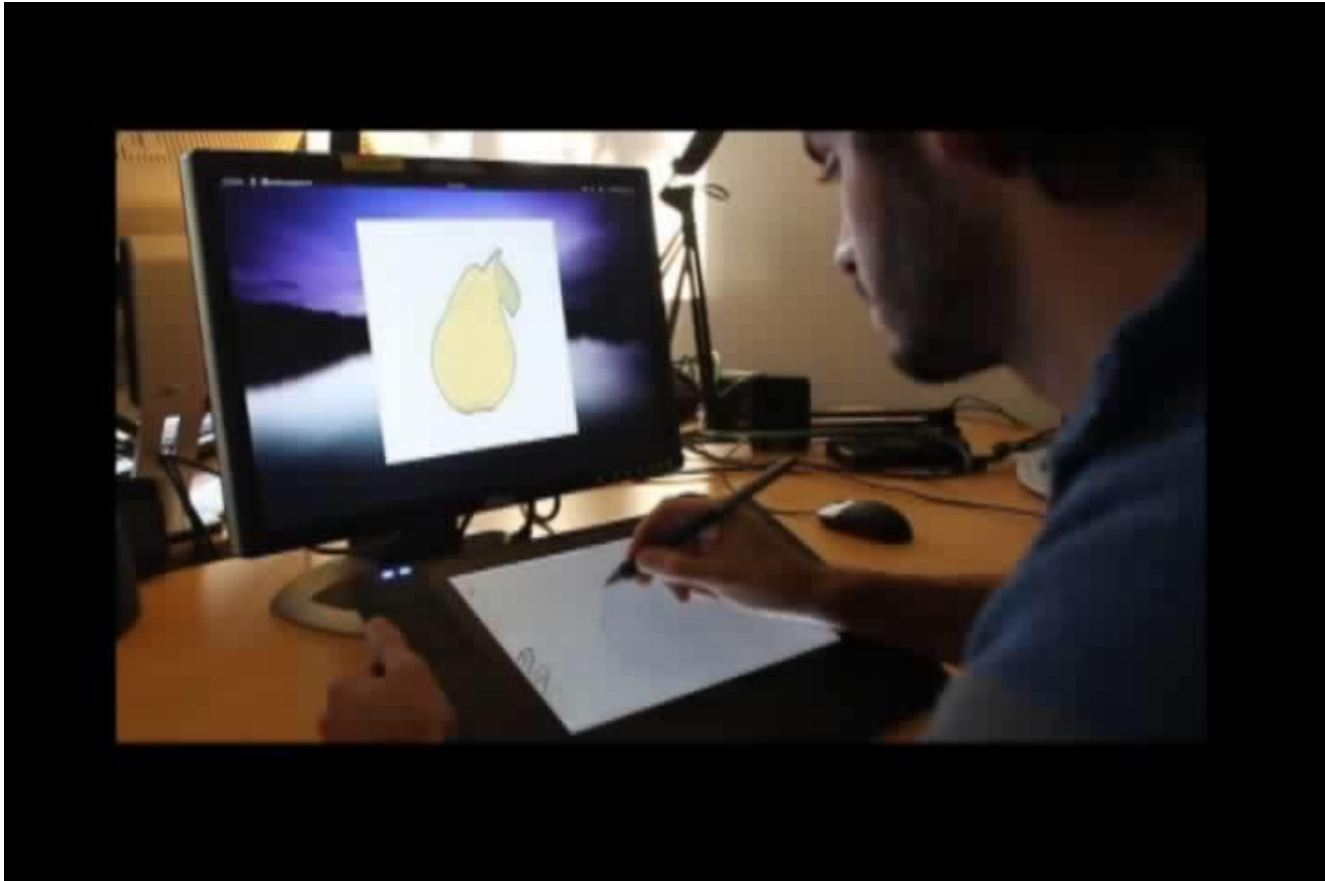
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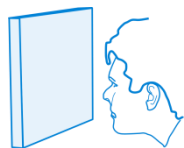
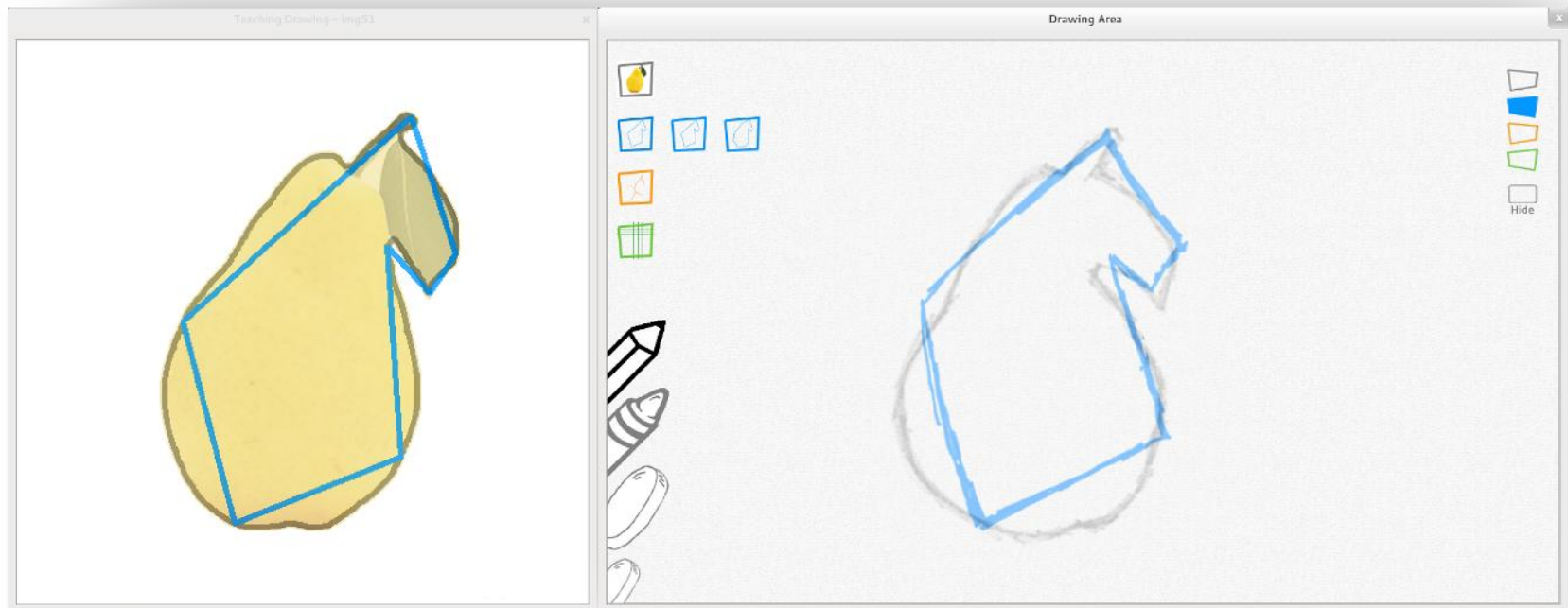


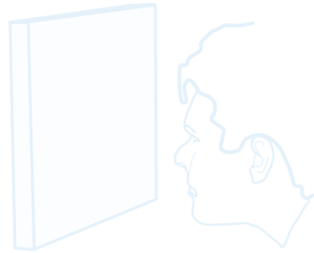
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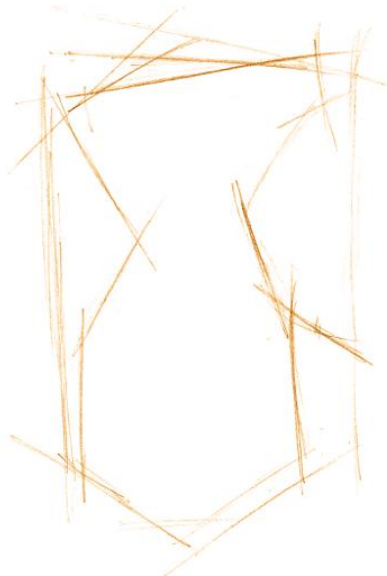
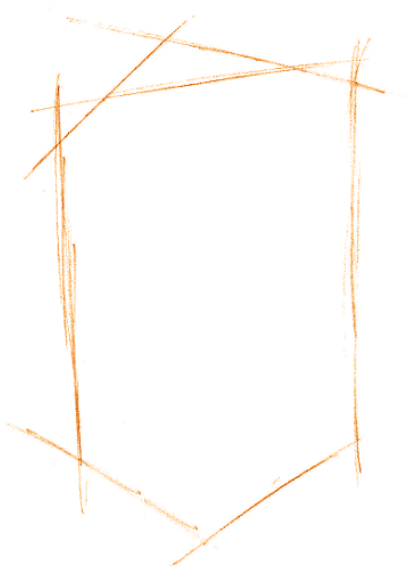
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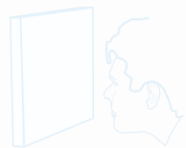
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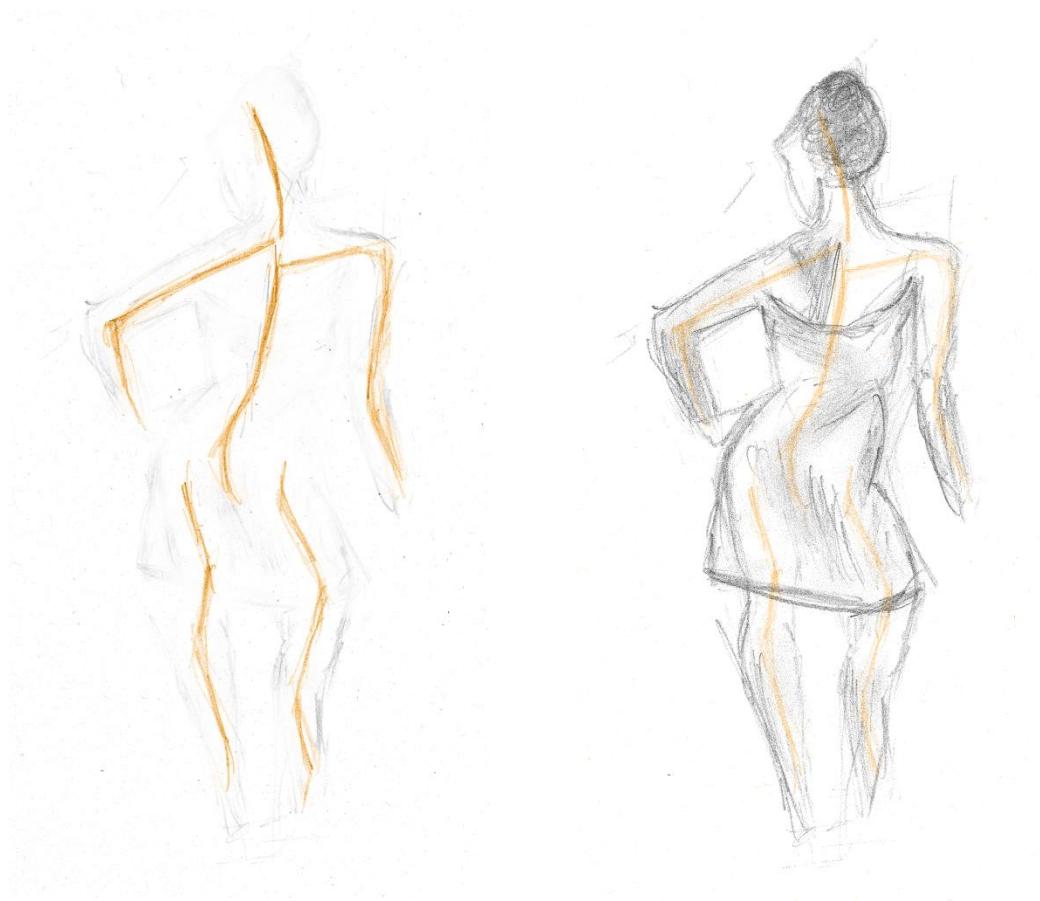


Support corrective feedback to help users understand their errors and refine their drawings.

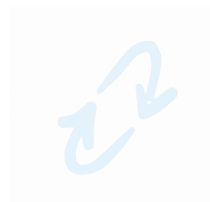


Lay down the main structure





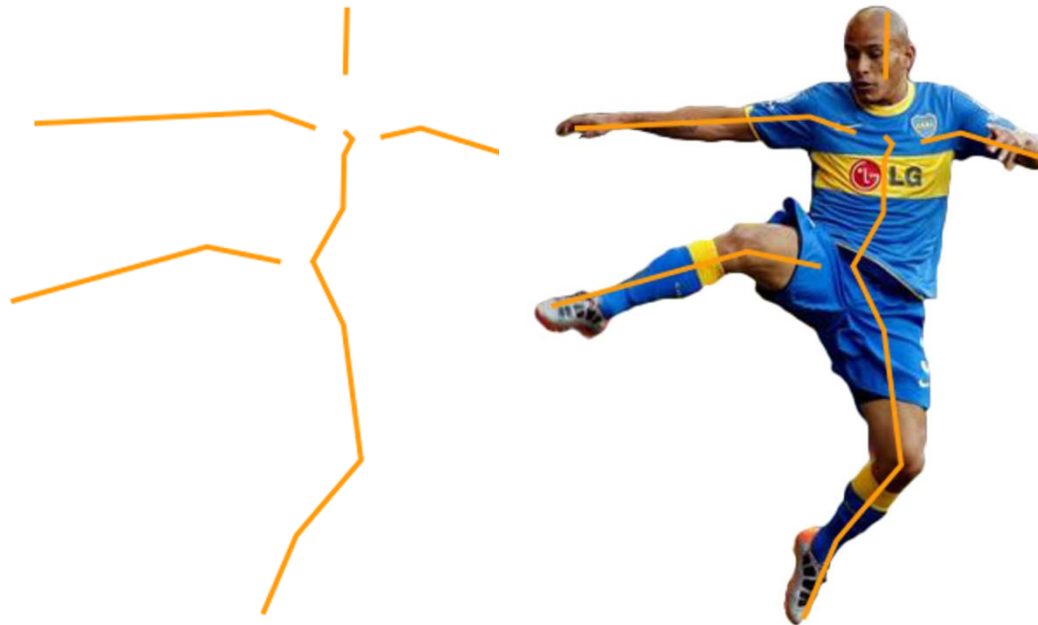
Lay down the main structure





Douglas-Peucker algorithm
[Douglas and Peucker 1973]





Medial Axis algorithm
[Blum et al. 1967]





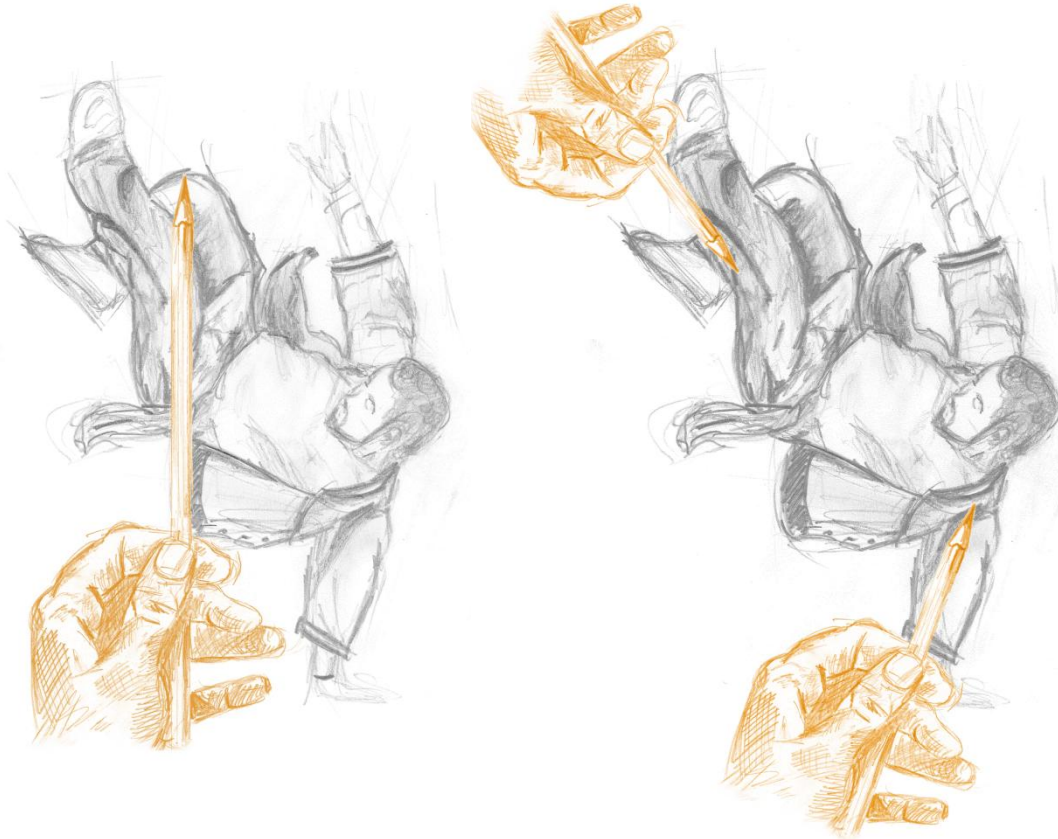
Draw contours of large
regions first, and then details





Contour detection and hierarchical image segmentation
[Arbalaez et al. 2011]





Proportions and alignments should be verified





Good features to track
[Shi and Tomasi 1994]





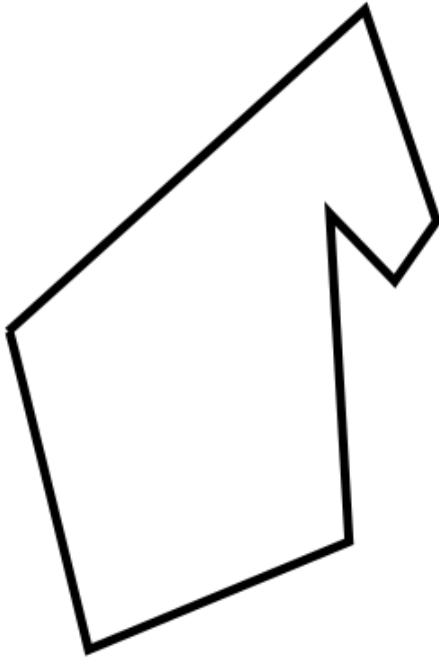
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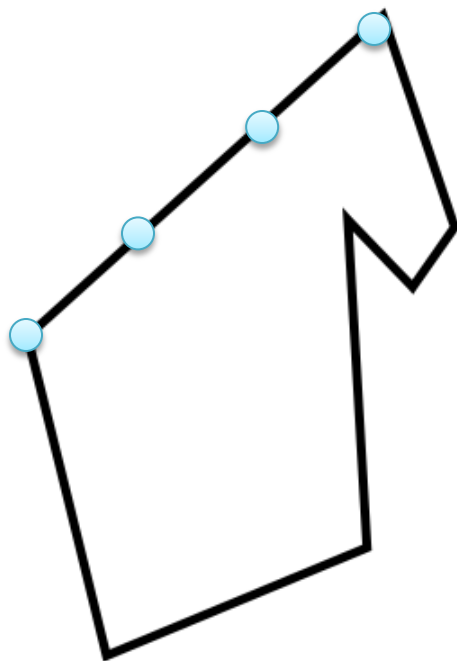


Model

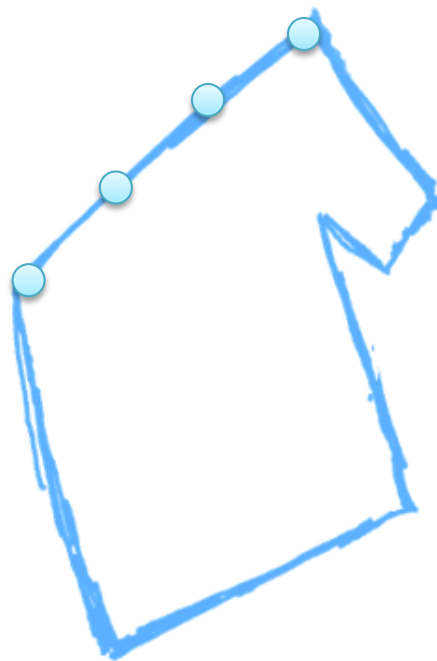


Drawing



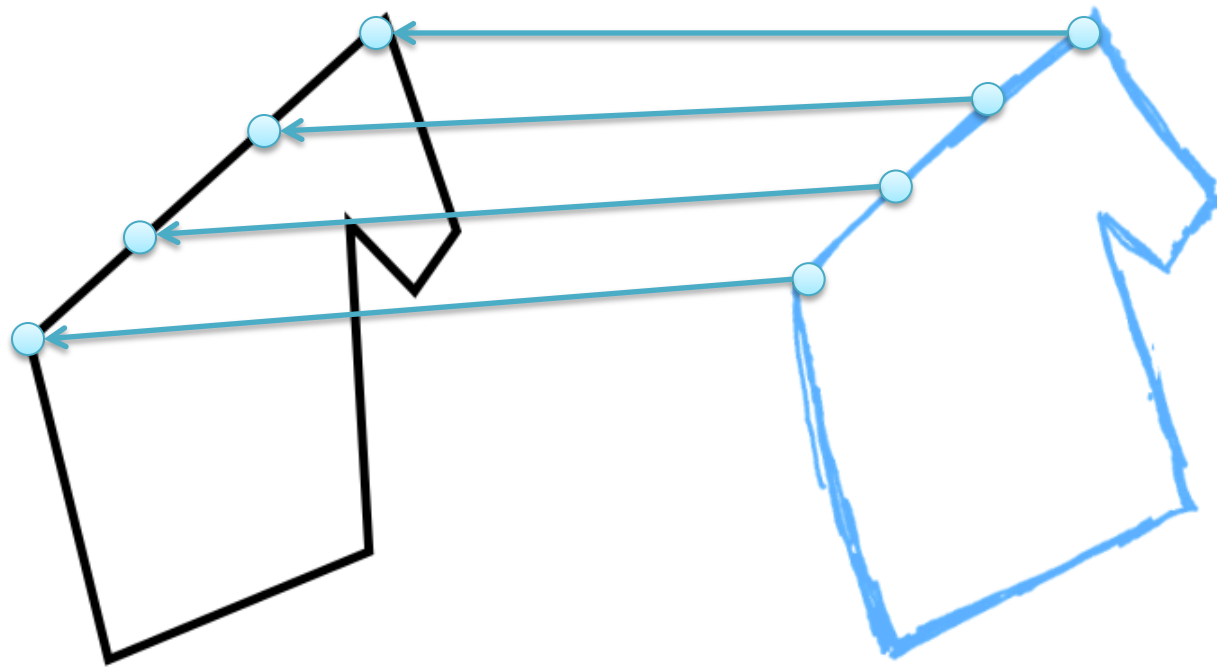


Model



Drawing





Model

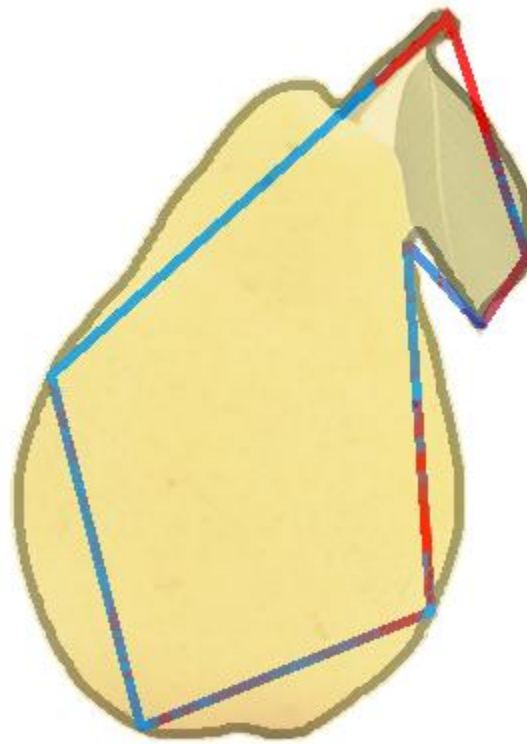
Drawing





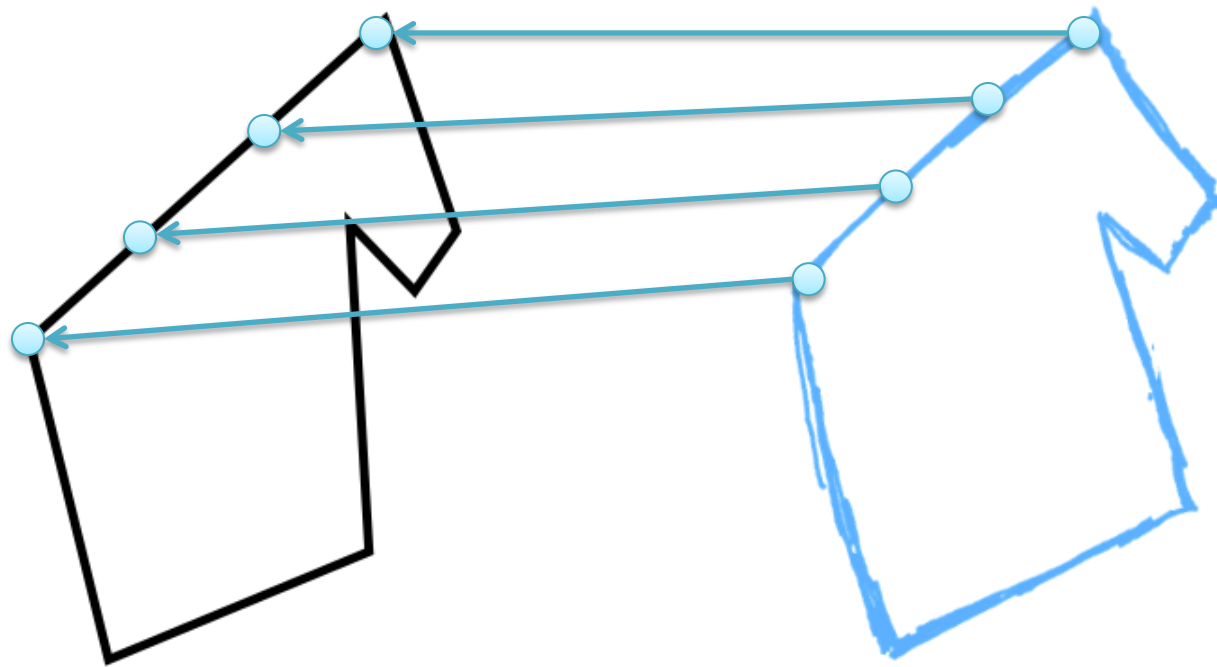
Dense Matching





Dense Feedback



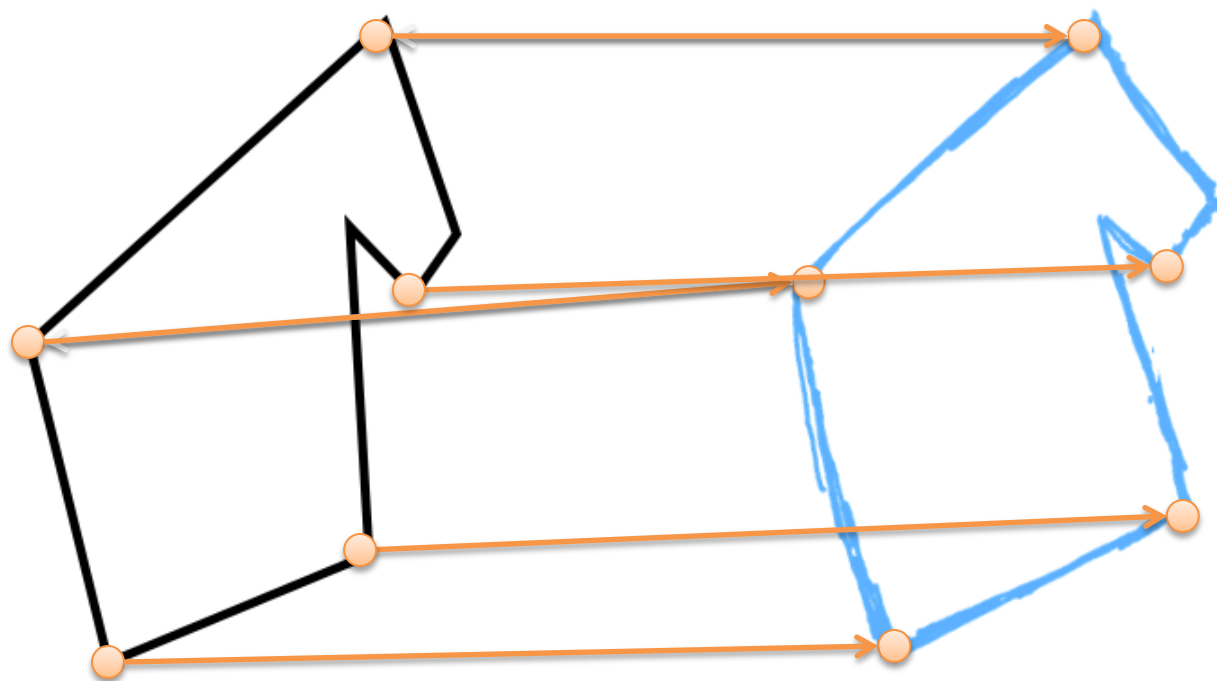


Model

Drawing

Dense Matching

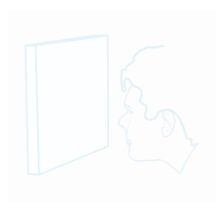


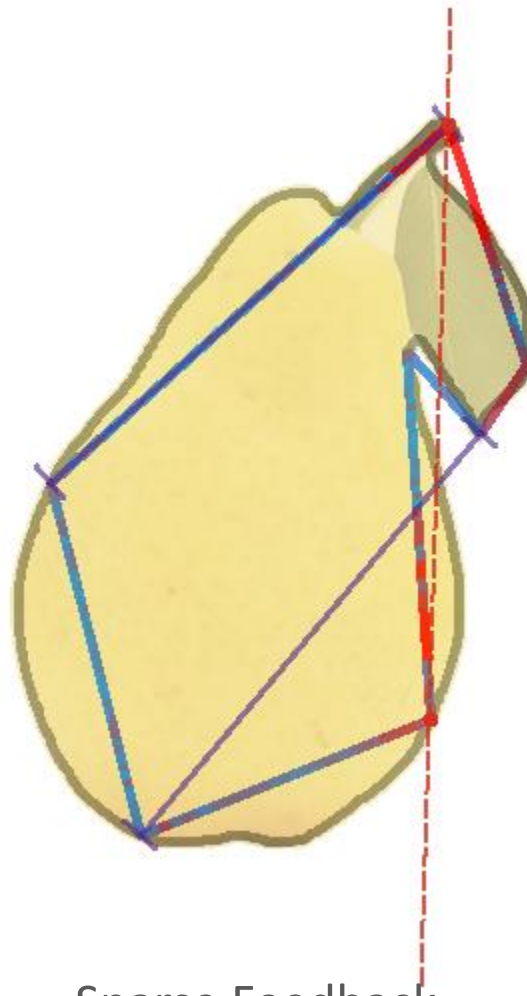


Model

Drawing

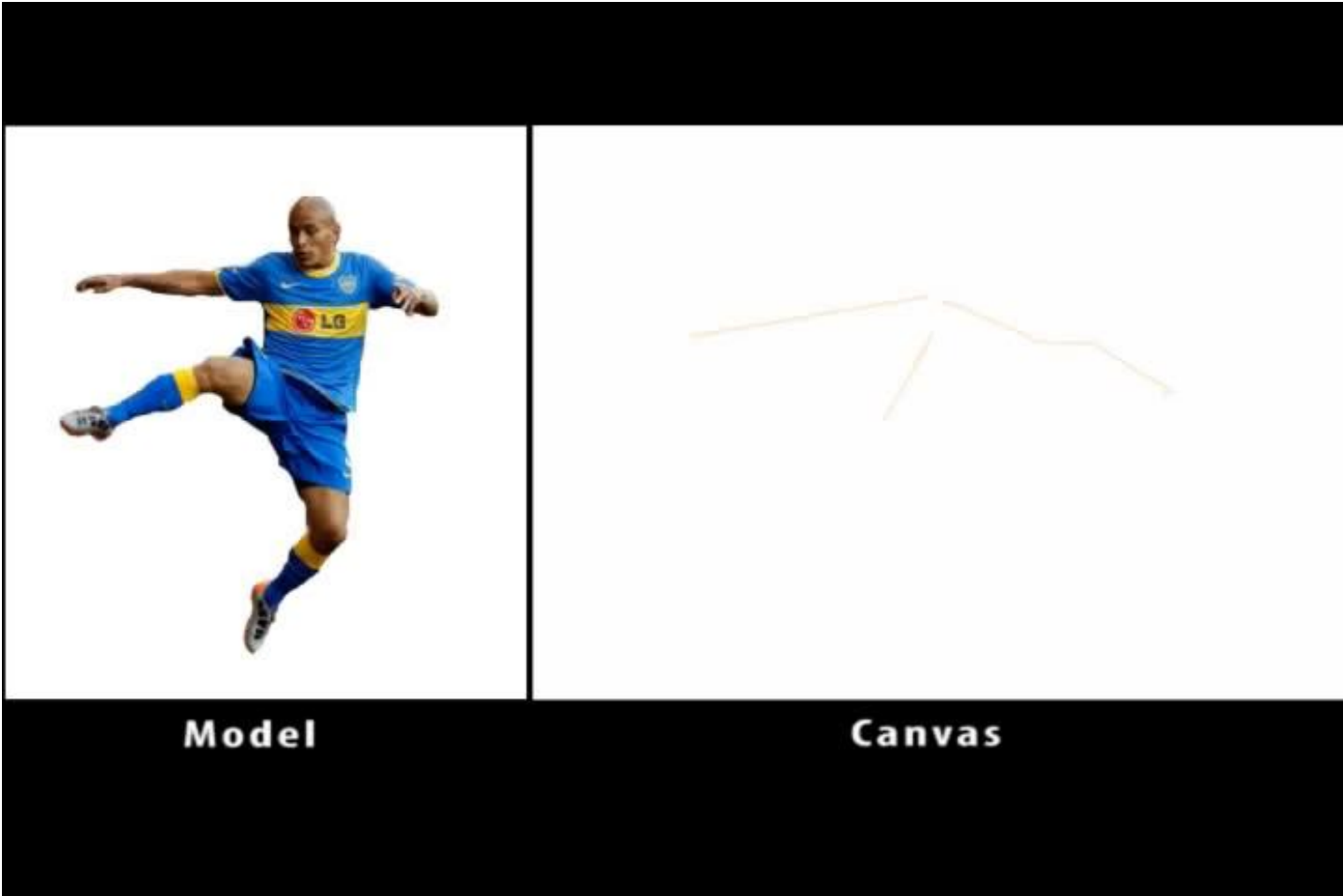
Sparse Matching





Sparse Feedback

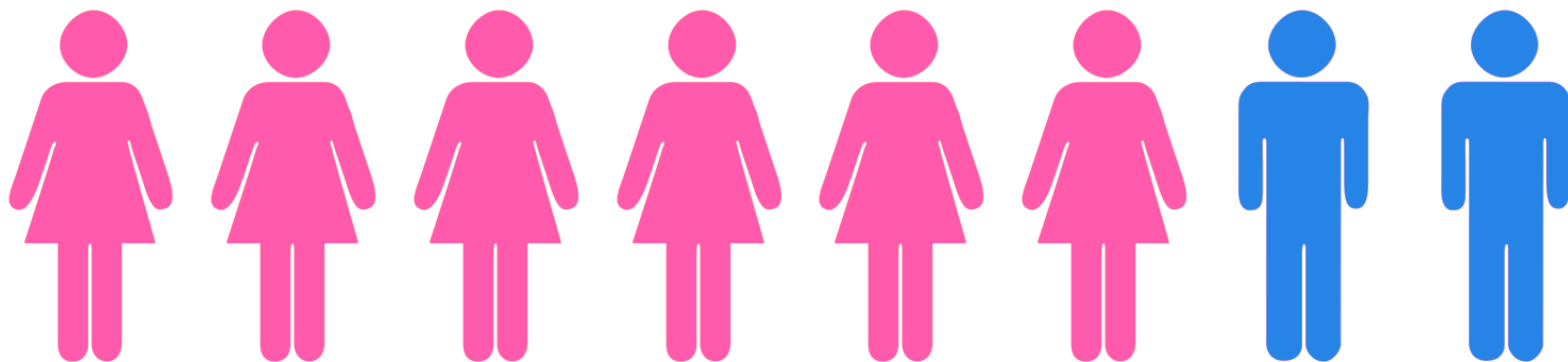




Model

Canvas

Evaluation



6 women

2 men



23 to 43 years old



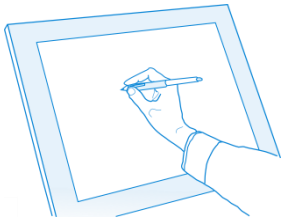
Poor

Below Avg.

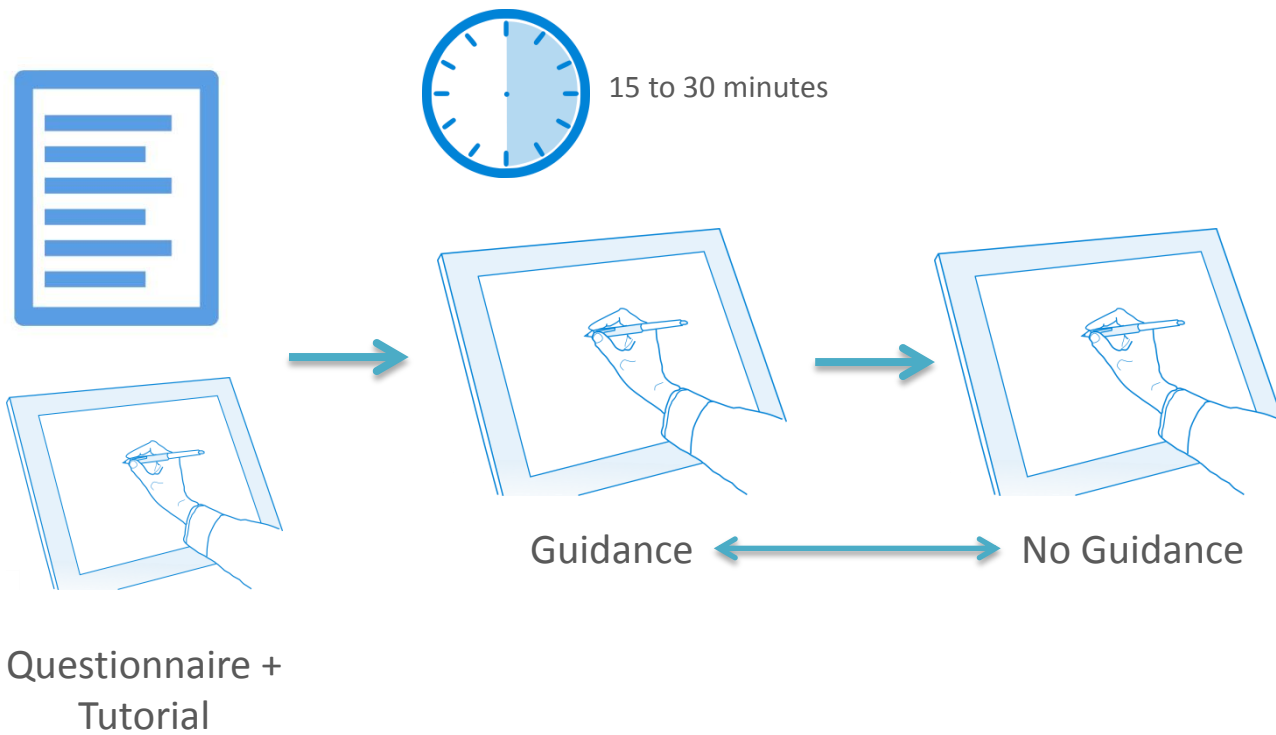
Average

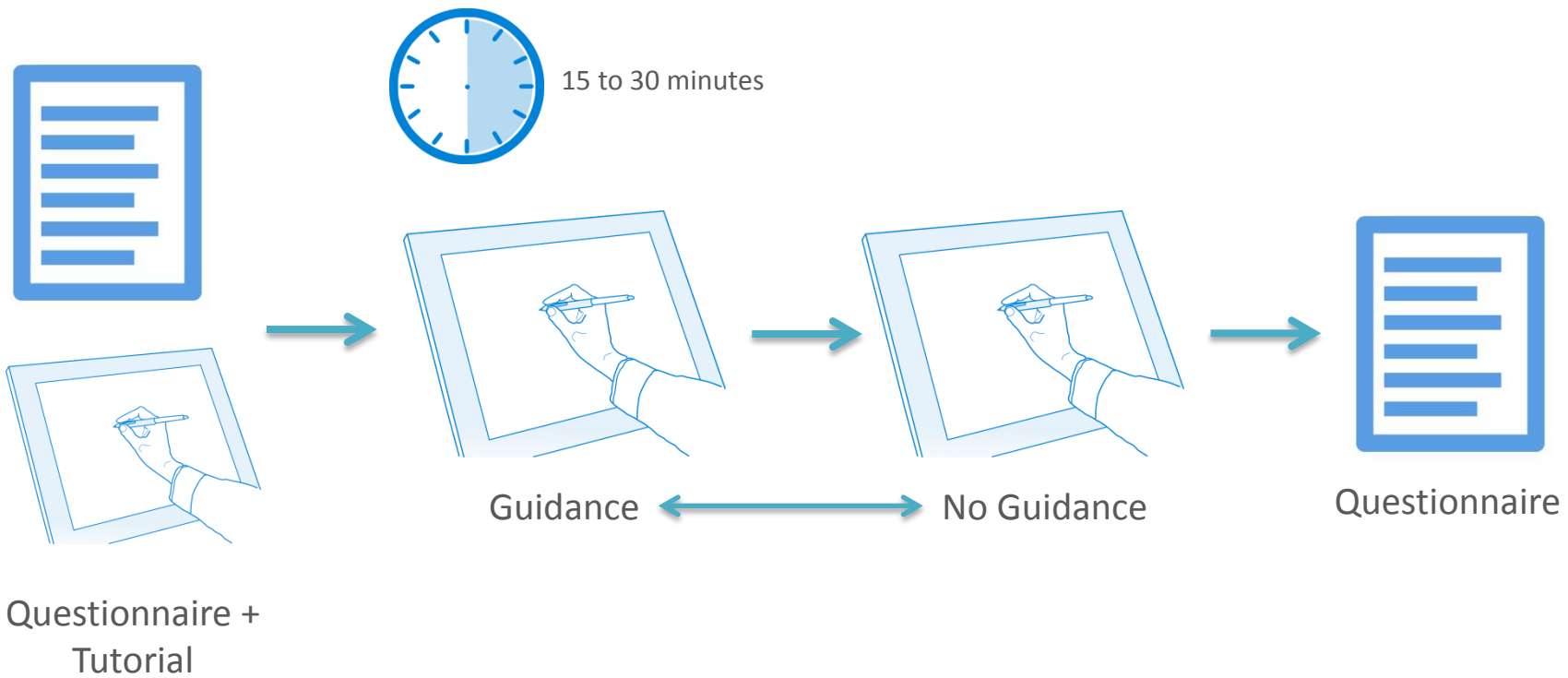
Above Avg.

Good

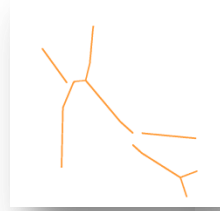


Questionnaire +
Tutorial

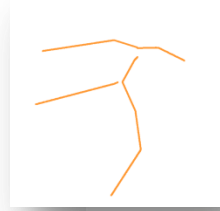
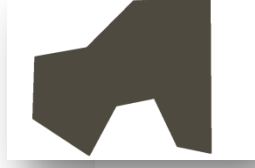




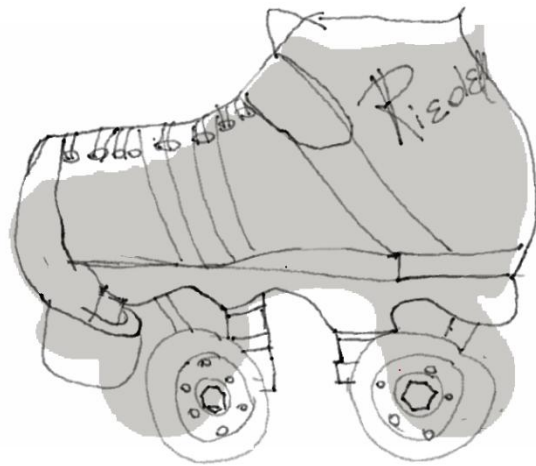
Skeleton images



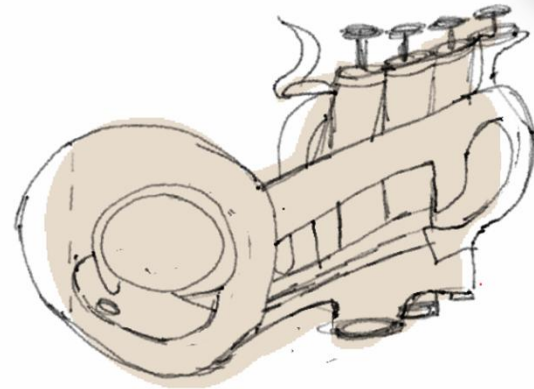
Block-in images



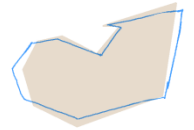
Results

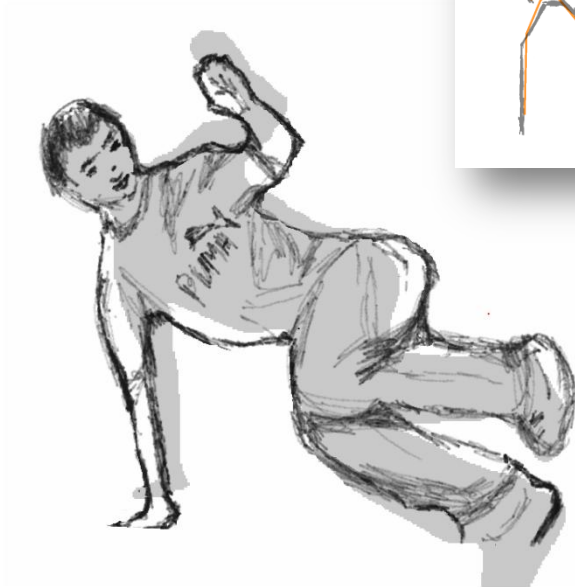


No guidance (37.9 px)



With guidance (16.3 px)





With guidance (20.8 px)



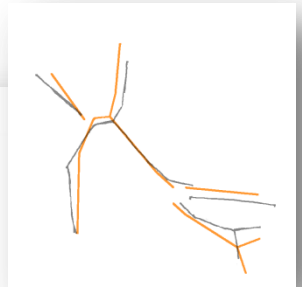
No guidance (37.1 px)

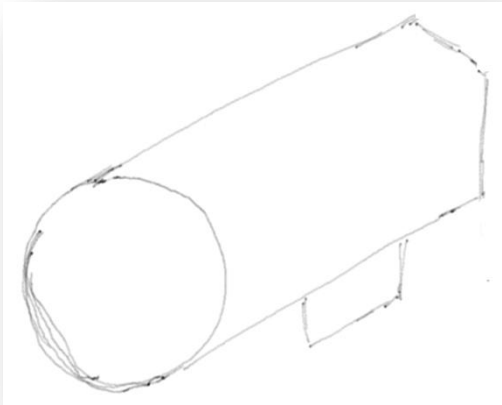


No guidance (14.7 px)

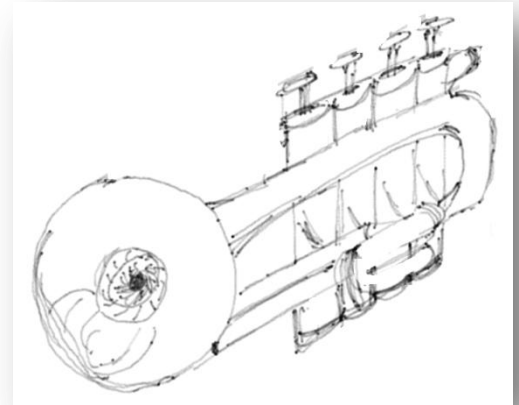
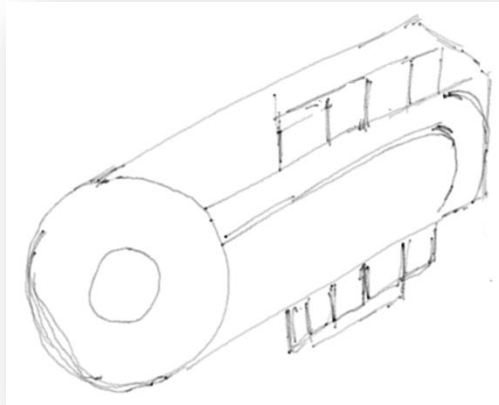


With guidance (18.0 px)

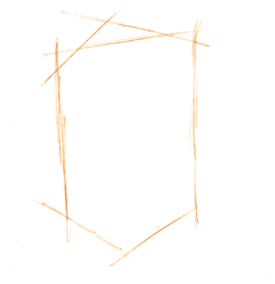




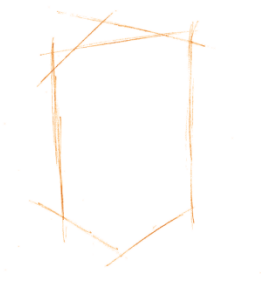
User's block-in lines



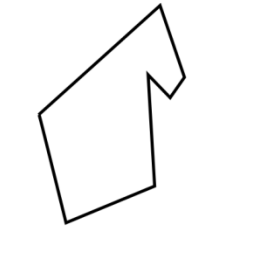
Final drawing



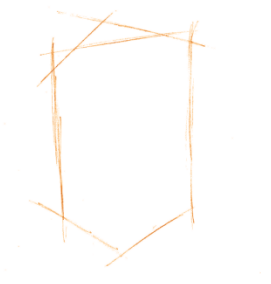
We distill traditional observation techniques and we derive a set of visual guides.



We distill traditional observation techniques and we derive a set of visual guides.



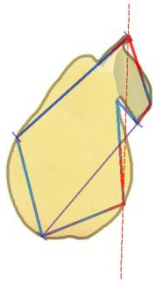
We automate those guides, using simple computer vision algorithms.



We distill traditional observation techniques and we derive a set of visual guides.



We automate those guides, using simple computer vision algorithms.



We perform real-time registration, which allows us to detect errors and provide feedback.

- **Arbelaez, P., Maire, M., Fowlkes, C., and Malik, J.** Contour detection and hierarchical image segmentation. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 99 (2011), 1–1.
- **Blum, H., et al.** A transformation for extracting new descriptors of shape. *Models for the perception of speech and visual form* 19, 5 (1967), 362–380.
- **Dixon, D., Prasad, M., and Hammond, T.** iCanDraw: Using sketch recognition and corrective feedback to assist a user in drawing human faces. In *Proc. of the International Conference on Human Factors in Computing Systems (CHI)*, ACM (2010).
- **Dodson, B.** *Keys to drawing*. North Light Books, 1985.
- **Douglas, D. H., and Peucker, T. K.** Algorithms for the reduction of the number of points required to represent a digitized line or its caricature. *Cartographica: The International Journal for Geographic Information and Geovisualization* 10, 2 (Oct. 1973), 112–122.
- **Edwards, B.** *Drawing on the right side of the brain*. Tarcher, 1979.
- **Eitz, M., Hays, J., and Alexa, M.** How do humans sketch objects? *ACM Transactions on Graphics (Proc. SIGGRAPH)* 31, 4 (2012), 44.
- **Lee, Y., Zitnick, C., and Cohen, M.** Shadowdraw: real-time user guidance for freehand drawing. In *ACM Transactions on Graphics (TOG)*, vol. 30, ACM (2011), 27.
- **Shi, J., and Tomasi, C.** Good features to track. In *Computer Vision and Pattern Recognition, 1994. Proceedings CVPR'94., 1994 IEEE Computer Society Conference on*, IEEE (1994).



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