**Haptic History**

1. “Touching, as we all know, is ___________ and serial.”

2. “Touching is the new ___________.”

3. “One way of thinking of a ________________ device is as a small personal robot... but instead of the robot interacting with the environment, the robot is interacting with a ________________, and that’s a very big difference.”

4. “Haptic interfaces is an intensely multidisciplinary field... divided into 3 main areas:”
   - ________________ haptics
   - ________________ haptics
   - ________________ haptics

5. “Haptics is a youthful field and has roots in __________ and __________. One of the first tele-operated devices was done by GE in the 60’s.”

6. “So were into the 70’s, and there has been a lot of work being driven by __________. The first tactile display... is actually the Optacon... [which] could help people read __________.”

7. 80’s “force feedback” improved ________________ performance.”

8. “In the early 90’s was the first time someone actually did something called the haptic ________________, Margaret M. did something called virtual sandpaper which... [you could] display textures and feel artificially.”

9. The ________________ was first invented and sold in 1995 and that made a huge difference in the field, because for the first time you didn’t have to be a ME to work in the field of haptic feedback... They recently released one for $2,000 [called the Phantom Omni; we have two of them in the ECE Department!].”
10. In the late 90s, there took place some psychophysical studies which were actually trying to help
______________________________.

11. In the early 2000’s... there was some movement from the stand-alone devices more into the idea of
______________________________: integrating haptic devices in the world around you.”

## Human Haptic Sensing

12. "This is a little bit of ___________________ skin, that’s non-hairy skin... there is stuff right at the surface that gets
the ___________________ transients [and] there is stuff deeper down that gets stimulated only when there is
____________________________ pressure.”

13. [Spatiotemporal resolution]
   What spacing is required for distinct perception?

   Spatial resolution depends upon the size of the ___________________.

   Successiveness, the temporal limits:
   ____ msec to perceive as separate
   ____ msec to determine order
   Masking: stimuli ____________________.

14. “____________________________ is the perception of limb
motion and force, as opposed to __________________ which is in your skin.”

15. [Muscle Mechanoreceptors]
   two types:
   Force sensors: measure __________________________
   Position sensors: excited by ______________________
16. "Human motor control is tightly integrated with sensory apparatus. We do two main things with our bodies:"

_________________________ tasks and
_________________________ tasks.

17. Key parameters of control are:

_________________________ capacity and
_________________________.

18. Exploratory procedures:

Lateral motion: ____________________
Pressure: ____________________
Holding: ____________________
Contour: ____________________

19. Force exertion:

_______________ grasps
_______________ grasps

20. "Haptic icons... are brief ____________________ computer generated signals... [which] are displayed to users through ____________________ feedback."

21. First step: What “feels” can be distinguished? __________ of haptic icons are hard to design.

22. So how do you do this? One approach that we have taken is iterative perceptual design to systematically maximize

_________________________ discriminability of icon set
_________________________ to targets.

23. The next step is to associate them with something. Can be used as haptic ____________________ and background ____________________ communication.