# CSci 8980
# Project - Stick Solo
# Proposal

Yashasvi Sriram Patkuri - patku001@umn.edu

September 28, 2022

**description**   The problem is to generate a controller for a given (human-like) stick-figure agent for the task of wall climbing (as in bouldering) so that the agent reaches the goal in a natural motion. The environment and agent will be mostly in 2D. The focus will be on using optimization based methods.

**members**
   1. Yashasvi Sriram Patkuri - patku001@umn.edu

**baseline**   Baseline is chosen as previous work on this problem, by me, using classical methods. Demo: `https://www.youtube.com/watch?v=bZg6pS2gGPw`. Github: `https://github.com/buggedbit/stick-solo`.

**oracle**   There are two components of evaluation in this problem.
   1. Reaching the goal.
   2. Moving naturally.
While the first one can be evaluated automatically, the latter one is best evaluated using user-studies for now. For example, if the controller produces motion for a climbing route which is not very distinguishable from some human climber's motion, that's a point. An arbitrary threshold for number of such points can be set as one evaluation metric.

**academic papers**   [Bull et al., 1995] proposes wall climbing robot gait control using genetic algorithms and Q-learning. [Grieco et al., 1998] and [Nagakubo and Hirose, 1994] demonstrate wall-climbing robots. [Kalisiak and Van de Panne, 2001] is one of the first papers to work on animating 2D parkour agents. [Naderi et al., 2017] addresses the problem of offline path and movement planning for wall climbing humanoid agents. [Peng et al., 2017] discusses the idea of hierarchical controller generation for the tasks of walking, running, jogging. This is what I intend to apply to the task of wall climbing.

**time estimates** I think there are two major parts to the project. Generating controller for local movements and higher level path planning. Depending on how the first part evolves the time for second one might vary. The most time in the first part should be taken by formulating dynamics, comparing and choosing RL algorithms, reward functions, implementation and debugging for incrementally sophisticated agents.

# References

[Bull et al., 1995] Bull, L., Fogarty, T. C., Mikami, S., and Thomas, J. G. (1995). Adaptive gait acquisition using multi-agent learning for wall climbing robots. *Automation and Robotics in Construction XII*, pages 80–86.

[Grieco et al., 1998] Grieco, J. C., Prieto, M., Armada, M., and de Santos, P. G. (1998). A six-legged climbing robot for high payloads. *Proceedings of the 1998 IEEE International Conference on Control Applications (Cat. No.98CH36104)*, 1:446–450 vol.1.

[Kalisiak and Van de Panne, 2001] Kalisiak, M. and Van de Panne, M. (2001). A grasp-based motion planning algorithm for character animation. *The Journal of Visualization and Computer Animation*, 12(3):117–129.

[Naderi et al., 2017] Naderi, K., Rajamäki, J., and Hämäläinen, P. (2017). Discovering and synthesizing humanoid climbing movements. *ACM Trans. Graph.*, 36(4).

[Nagakubo and Hirose, 1994] Nagakubo, A. and Hirose, S. (1994). Walking and running of the quadruped wall-climbing robot. In *Proceedings of the 1994 IEEE International Conference on Robotics and Automation*, pages 1005–1012 vol.2.

[Peng et al., 2017] Peng, X. B., Berseth, G., Yin, K., and van de Panne, M. (2017). Deeploco: Dynamic locomotion skills using hierarchical deep reinforcement learning. *ACM Transactions on Graphics (Proc. SIGGRAPH 2017)*, 36(4).