MECHANICAL CRANE
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HOW IT WORKS
In order to lift a pound weight, our group had a long square hollow beam attached to a sturdy body frame. This beam was attached at an angle, so we used a square hollow design that would withstand torsion well. For the body frame, we had triangular truss mounted on a base to achieve high performance against compressive force induced by lifting the weight. When the servo motor was switched on, the motor rotated the arm, which in turn lifted the weight.

Interesting and Original Features:
- Hollow square beam
- Counterweight attached at the arm
- U-Bracket as a base

THEORETICAL PREDICTIONS
The manufacturer specified that the servo motor was capable of providing $T = 72$ oz-in (4.5 lb-in), with an angular rotation of $\alpha = 90^\circ$.

The crane was required to lift a 1 lb weight, 2 inches. Using the specifications and requirements enabled us to produce the following geometry and predictions:

$\alpha = 90^\circ$

$T = 4.5$ lb-in

$L = 2$

$\sum M | o = 0$:

$T = 4L_{\max}$

$L_{\max} = 4.5$ in

Minimum $L$ (Based on lift of 2.5 in):

$2L_{\min} = 2.52$

$L_{\min} = 1.26$ in

From these calculations we predicted that if we had an arm of 1.75 inches, the servo motor would be able to lift the weight 2.5 in, utilizing 40% of the servo’s maximum torque.

PERFORMANCE
During our first review, the crane weighed 7.3 ounces and lifted the weight 1.5 inches. The design at this time used an I-beam as the arm, and we found that this did not resist torsional stresses well. Also, the lever arm was not heavy enough to use the servo’s maximum torque during this review, so we decided to add a counterweight for the next iteration.

During the final review, the crane weighed 11 ounces and lifted the weight 2.5 inches. The square beam design helped resist the torsional stresses that were an issue in the first review, and the counterweight allowed the servo to fully power the lever arm.

Rather than using a flat plate as the base of our crane, we sliced a U-bracket down the centerline and used the two pieces as the clamping surface. We then drilled directly into U-bracket to connect it to the legs of the base.