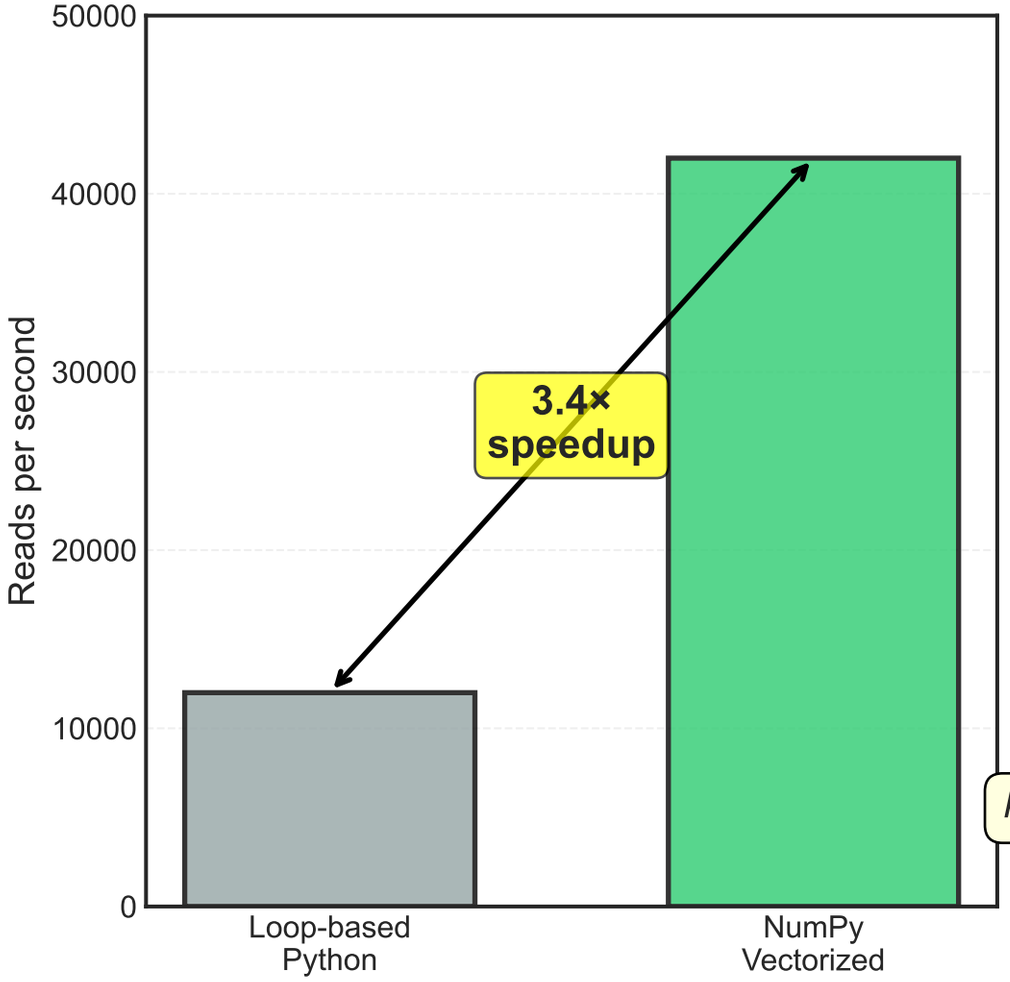
A) Impact of NumPy Vectorization



B) Vectorization Strategy

Traditional

```
# Traditional Python (slow)
for candidate in candidates:
    mismatches = 0
    for i in range(read_
        if ref[candidate
            mismatches +=
    if mismatches < best
        best = mismatche
```

VecMap

```
# VecMap (fast)
substrs = ref_arr[candidates[:, None] +
                  np.arange(read_len)]
mismatches = (substrs != read_arr).sum(axis=1)
best_pos = candidates[mismatches.argmin()]
```

Key Insight: NumPy moves the inner loop from Python to optimized C