

## Sample GC problem

For this problem you will manually simulate a tracing garbage collector that uses a *conservative mark-and-sweep* algorithm to clean up allocated space. The garbage collector will perform immediate coalescing on all blocks it deallocates, and will also assume that all addresses in memory are word-aligned.

Below to the left are the values of all global and local variables in the process, and the first diagram to the right depicts the contents of the heap. You are to perform garbage collection in two steps — in step (1) shade in all the *marked* blocks, and in step (2) show the resulting heap after the *sweep* step. Note that you only need to show changed header/footer words in (2).

```

/* local vars */
int i = 0x00EF0100;
int j = 0xDEADBEEF;
char *p = 0x80005040;
char *q = 0x00000000;

/* global vars */
int N = 0x80005000;
char *GLOB = 0x80005010;

```

| Current heap: |            | (1) Marked blocks: |      | (2) After sweep: |      |
|---------------|------------|--------------------|------|------------------|------|
| Addr.         | Data       | Addr.              | Data | Addr.            | Data |
| 0x80005068    | 0x0000000D | 0x80005068         |      | 0x80005068       |      |
| 0x...5064     | 0x8000504C | 0x...5064          |      | 0x...5064        |      |
| 0x...5060     | 0x0000000D | 0x...5060          |      | 0x...5060        |      |
| 0x...505c     | 0x00000019 | 0x...505c          |      | 0x...505c        |      |
| 0x...5058     | 0xFFFFFFFF | 0x...5058          |      | 0x...5058        |      |
| 0x...5054     | 0x30000000 | 0x...5054          |      | 0x...5054        |      |
| 0x...5050     | 0x20000000 | 0x...5050          |      | 0x...5050        |      |
| 0x...504c     | 0x10000000 | 0x...504c          |      | 0x...504c        |      |
| 0x...5048     | 0x00000019 | 0x...5048          |      | 0x...5048        |      |
| 0x...5044     | 0x0000000D | 0x...5044          |      | 0x...5044        |      |
| 0x...5040     | 0xDEADBEEF | 0x...5040          |      | 0x...5040        |      |
| 0x...503c     | 0x0000000D | 0x...503c          |      | 0x...503c        |      |
| 0x...5038     | 0x00000015 | 0x...5038          |      | 0x...5038        |      |
| 0x...5034     | 0x000000A0 | 0x...5034          |      | 0x...5034        |      |
| 0x...5030     | 0x64656600 | 0x...5030          |      | 0x...5030        |      |
| 0x...502c     | 0x60616263 | 0x...502c          |      | 0x...502c        |      |
| 0x...5028     | 0x00000015 | 0x...5028          |      | 0x...5028        |      |
| 0x...5024     | 0x0000000C | 0x...5024          |      | 0x...5024        |      |
| 0x...5020     | 0x01020304 | 0x...5020          |      | 0x...5020        |      |
| 0x...501c     | 0x0000000C | 0x...501c          |      | 0x...501c        |      |
| 0x...5018     | 0x00000011 | 0x...5018          |      | 0x...5018        |      |
| 0x...5014     | 0x80005064 | 0x...5014          |      | 0x...5014        |      |
| 0x...5010     | 0xB0B0B0B0 | 0x...5010          |      | 0x...5010        |      |
| 0x...500c     | 0x00000011 | 0x...500c          |      | 0x...500c        |      |
| 0x...5008     | 0x0000000C | 0x...5008          |      | 0x...5008        |      |
| 0x...5004     | 0x80005004 | 0x...5004          |      | 0x...5004        |      |
| 0x80005000    | 0x0000000C | 0x80005000         |      | 0x80005000       |      |