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Programlama: Çok Seviyeli Geri Bildirim Kuyruğu

Bu bölümde **Çok Düzeyli Geri Bildirim Kuyruğu (Multi-level Feed-back Queue) (MLFQ)** olarak bilinen programlamaya yönelik en iyi bilinen yaklaşımlardan birini geliştirme sorununu ele alacağız. Çok Düzeyli Geri Bildirim Kuyruğu (MLFQ) planlayıcısı ilk olarak Corbato ve arkadaşları tarafından tanımlanmıştır. 1962'de [C+62] Uyumlu Zaman Paylaşım Sistemi (CTSS) olarak bilinen bir sistemde ve bu çalışma daha sonra Multics üzerinde yapılan çalışmalarla birlikte, ACM'nin Corbato'ya en büyük ödülü olan **Turing Ödülü'nü (Turing Award)** almasına yol açtı. Zamanlayıcı daha sonra yıllar boyunca bazı modern sistemlerde karşılaşacağınız uygulamalara göre geliştirilmiştir.

MLFQ'nun ele almaya çalıştığı temel sorun iki yönlüdür. İlk olarak *geri dönüş süresini (turnaround time)* optimize etmek ister, bu da önceki notta gördüğümüz gibi önce daha kısa işleri çalıştırarak yapılır; ne yazık ki işletim sistemi genellikle bir işin ne kadar süre çalışacağını bilemez, tam da SFJ (veya STCF) gibi algoritmaların gerektirdiği bilgi. İkinci olarak, bir sistemin etkileşimli kullanıcı (yani oturan ekrana bakan, bir işlemin bitmesini bekleyen kullanıcılar) aşırı duyarlı olmasını ve böylece *yanıt süresini (response time)* en aza indirmesini ister; ne yazık ki, Round-Robin gibi algoritmalar yanıt süresini azaltır ancak geri dönüş süresi açısından oldukça korkunçtur. Dolayısıyla sorunumuz şu: Genel olarak bir süreç için nasıl bir süreç hakkında hiçbir şey bilmediğimiz göz önüne alındığında, bu hedeflere ulaşmak için nasıl bir zamanlayıcı oluşturabiliriz? Zamanlayıcı, sistem çalıştıkça çalıştırdığı işlerin özelliklerini nasıl öğrenebilir ve böylece daha iyi zamanlama kararları verebilir?

ÖNEMLİ NOKTA:
MÜKEMMEL BİLGİ OLMADAN NASIL PROGRAMLAMA YAPILIR?

Hem etkileşimli işler için yanıt süresini en aza indiren hem de iş uzunluğu hakkında önceden bir *öngörü(priori*) sahibi olmadan geri dönüş süresini en aza indiren zamanlayıcı nasıl tasarlanabilir?

İPUCU: TARİHTEN ÖĞRENİN

Çok seviyeli geri bildirim kuyruğu, geleceği tahmin etmek için geçmişten öğrenen bir sistemin mükemmel bir örneğidir. Bu tür yaklaşımlar işletim sistemlerinde (ve donanım dallanma tahmin edicileri ve önbellek algoritmaları dahil olmak üzere Bilgisayar Bilimindeki diğer birçok yerinde) yaygın olarak kullanılmaktadır. Bu tür yaklaşımlar, işlerin davranış aşamaları olduğunda ve bu nedenle önceden belirlenebilir olduğunda işe yarar; Elbette, bu tür tekniklerde dikkatli olunmalıdır çünkü kolayca yanlış olabilirler ve sistemi hiç bilgi sahibi olmadıklarından daha kötü kararlar almaya yönlendirebilirler.

8.1 MLFQ: TEMEL KURALLAR

Böyle bir zamanlayıcı oluşturmak için, bu bölümde çok seviyeli bir geri bildirim kuyruğunun arkasındaki temel algoritmaları açıklayacağız; Uygulamanın birçok MLFQ'nun özellikleri farklı olsa da [E95], çoğu yaklaşımı benzerdir.

Bizim uygulamamızda, MLFQ'nun her biri farklı bir **öncelik seviyesi (priority level)** atanmış bir dizi farklı **kuyruğu(queues)** vardır.

Herhangi bir zamanda, çalışmaya hazır olan bir iş tek bir kuyruktadır. MLFQ, belirli bir zamanda hangi işin çalıştırılacağına karar vermek için öncelikleri kullanır: daha yüksek önceliğe sahip bir iş (yani, daha yüksek kuyruktaki bir iş) çalıştırılmak üzere seçilir.

Tabii ki, birden fazla iş belirli bir kuyrukta olabilir ve bu nedenle **aynı önceliğe (same priority**) sahip olabilir. Bu durumda, bu işler arasında sadece hepsini bir kez deneme zamanlamasını kullanacağız.

Böylece, MLFQ için iki temel kurala ulaşıyoruz:

- **Kural 1:** Öncelik8(A) > Öncelik(B) ise, A çalışır (B çalışmaz)
- **Kural 2:** Öncelik (A) = Öncelik B ise, A & B RR'de çalışır.

Bu nedenle, MLFQ zamanlamasının anahtarı, zamanlayıcının öncelikleri nasıl belirlediğine bağlıdır. MLFQ, her işe sabit bir öncelik vermek yerine, bir işin önceliğini *gözlemlenen davranışına (observed behavior)* göre *değiştirir(varies).* Örneğin, bir işin anahtar kartından giriş beklerken CPU'yu sürekli olarak bırakırsa, MLFQ önceliğini yüksek tutacaktır çünkü etkileşimli bir süreç bu şekilde davranabilir. Bunun yerine, bir iş CPU'yu uzun süre yoğun bir şekilde kullanıyorsa, MLFQ önceliğini azaltacaktır. Bu şekilde MLFQ çalışırken süreçler hakkında *bilgi edinmeye(learn*) çalışacak ve böylece *gelecekteki(future)* davranışını tahmin etmek için *geçmişini(history)* kullanacak.

Belirli bir anda kuyrukların nasıl görünebileceğinine dair bir resim ortaya koyacak olursak, aşağıdaki gibi bir şey görebiliriz (Şekil 8.1) Şekilde, iki iş (A ve B) en yüksek seviyesindeyken, C işi ortada ve D işi en düşük önceliktedir. MLFQ'nun nasıl çalışacağına dair mevcut biligilerimiz göz önüne alındığında, zamanlayıcı sistemdeki en yüksek öncelikli işler oldukları için zaman dilimlerini A ve B arasında değişecektir; zavallı C ve D işleri asla çalışamayacaktır – bu bir rezalet.

Tabii ki, sadece bazı kuyrukların statik bir anlık görüntüsünü göstermek, MLFQ'nun nasıl çalıştığı hakkında size bir fikir vermez. İhtiyacımız olan şey, iş önceliğinin zaman içinde nasıl *değiştiğini(changes)* anlamaktır.

Şekil 8.1: **MLFQ Örnek**

Ve bu, sadece bu kitaptaki bir bölümü ilk kez okuyanlar için sürpriz olarak, bundan sonra yapacağımız şey tam olarak budur.

8.2 Deneme #1: Öncelik Nasıl Değiştirilir

Şimdi MLFQ'nun bir işin öncelik seviyesini (ve dolayısıyla hangi kuyrukta olduğunu) bir işin ömrü boyunca nasıl değişebileceğine. Bunu yapmak için iş yükümüzü aklımızda tutmalıyız: kısa süreli (ve sıklıkla CPU'dan vazgeçebilen) etkileşimli işler ile çok fazla CPU zamanı gerektiren ancak yanıt süresinin önemli olmadığı daha uzun süre çalışan bazı "CPU'ya bağlı "işler. İşte öncelik ayarlama algoritmasına yönelik ilk denememiz:

- **Kural 3:** Bir iş sisteme girdiğinde, en yüksek önceliğe (en üst kuyruğa) yerleştirilir.
- **Kural 4a:** Bir iş çalışırken bir zaman diliminin tamamını kullanırsa, önceliği *azaltılır(reduced)* (yani bir sıra aşağı iner).
- **Kural 4b:** Bir iş zaman dilimi dolamadan CPU'dan vazgeçerse, *aynı(same)* öncelik seviyesinde kalır.

Örnek 1: Uzun Süre Çalışan Tek Bir İş

Şimdi bazı örneklere bakalım. İlk olarak, sistemde uzun süredir devam eden bir iş olduğunda ne olduğuna bakacağız. Şekil 8.2 üç sıralı bir zamanalayıcıda bu işe zaman içinde ne olduğunu göstermektedir.

Şekil 8.2: **Zaman İçinde Uzun Süreli İş**

Örnekte görebileceğiniz gibi, iş en yüksek öncelikte (Q2) girer. Tek bir 10 ms'lik zaman diliminden sonra, zamanlayıcı işin önceliğini bir azaltır ve böylece iş Q1'de olur. Bir zaman dilimi boyunca Q1'de çalıştıktan sonra, iş nihayet sistemdeki en düşük önceliğe(Q0) indirilir ve burda kalır. Oldukça basit, değil mi?

Örnek 2: Kısa Süreli Bir İş Geldi

Şimdi daha karmaşık bir örneğe bakalım ve MLFQ'nun SJF'ye nasıl yaklaşmaya çalıştığını görelim. Bu örnekte iki iş vardır: Uzun süre çalışan CPU yoğun bir iş olan A ve kısa süre çalışan etkileşimli bir iş olan B. A'nın bir süredir çalıştığını ve daha sonra B'nin durduğunu varsayalım. Bu durumda ne olacaktır? MLFQ, B için SJF'ye yaklaşacak mı?

Şekil 8.3 bu senaryonun sonuçlarını göstermektedir. A (siyahla gösterilen) en düşük öncelikli kuyrukta çalışmaktadır (uzun süre çalışan CPU yoğun işler gibi); B (gri ile gösterilen) T=100 zamanında gelir ve böylece en yüksek kuyruğa eklenir.

Şekil 8.3: **İnteraktif Bir İş Geldi**

Şekil 8.4: **G/Ç ve CPU Yoğun Karma Bir İş Yükü**

Çalışma süresi kısa olduğu için (sadece 20 ms), B iki zaman diliminde an alt kuyruğa ulaşmadan önce tamamlanır; sonra A çalışmaya devam eder (düşük öncelikte).

Bu örnekten, algoritmanın ana hedeflerinden birini anlayabileceğinizi umuyoruz: Bir işin kısa bir iş mi yoksa uzun soluklu bir iş mi olacağını *bilmediği(know)* için, önce kısa bir iş olabileceğini varsayar ve böylece işe yüksek öncelik verir. Eğer gerçekten kısa bir iş değilse, kuyruklarda yavaşça ilerleyecek ve böylece kısa süre sonra uzun süren daha toplu iş benzeri bir süreç olduğunu kanıtlayacaktır. Bu şekilde MLFQ, SJF'ye yaklaşır.

Örnek 3: G/Ç Hakkında Ne Düşünüyorsunuz?

Şimdi bazı G/Ç içeren bir örneğe bakalım. Yukarıda Kural4b'de belirtildiği gibi süreç zaman dilimini kullanmadan önce işlemciden vazgeçerse, onu aynı öncelik seviyesinde tutarız. Bu kuralın amacı basittir: örneğin etkileşimli bir iş çok fazla G/Ç yapıyorsa (örneğin klavye veya fareden kullanıcı girdisi bekleyerek), zaman dilimini tamamlamadan CPU'dan vazgeçecektir; böyle bir durumda işi cezalandırmak istemiyoruz ve bu nedenle onu aynı seviyede tutmak istemeyiz.

Şekil 8.4'te bunun nasıl çalıştığına dair bir örnek gösterilmektedir; etkileşimli bir iş olan B (gri renkle gösterilmiştir), uzun süredir çalışan bir toplu iş olan A (siyah renkle gösterilmiştir) ile CPU için rekabet eden bir G/Ç gerçekleştirmeden önce CPU'ya yalnız 1 ms ihtiyaç duymaktadır. MLFQ yaklaşımı B'yi en yüksek öncellikte tutar çünkü B CPU'yu serbest bırakmaya devam eder; B etkileşimli işleri hızlı bir şekilde çalıştırma hedefine daha da ulaşır.

Mevcut MLFQ ile İlgili Sorunlar

Böylece temel bir MLFQ'ya sahip olduk. CPU'yu uzun süre çalışan işler arasında adil bir şekilde paylaştırarak ve kısa veya G/Ç yoğun etileşimli işlerin hızlı bir şekilde çalışmasına izin vererek oldukça iyi bir iş çıkarıyor gibi görünüyor. Ne yazık ki, şimdiye kadar geliştirdiğimiz yaklaşım ciddi kusurlar içeriyor. Aklınıza gelen var mı?

(Burada durun ve olabileceğince dolambaçlı düşünün.)

Şekil 8.5: **Öncelik Artışı Olmadan (Sol) ve Öncelik Artışı İle (Sağ)**

İlk olarak, açlık sorunu vardır: "çok fazla "etkileşimli iş varsa *tüm(all)* CPU zamanını tüketmek için birleşecekler ve böylece uzun süredir devam eden işler *hiçbir zaman(never)* CPU zamanı almayacaklar (**açlıktan ölüyorlar(starve**)). Bu senaryoda bile bu işlerde biraz ilerleme kaydetmek istiyoruz.

İkinci olarak, akıllı kullanıcı **programını zamanlayıcı (game the scheduler)** ile oynamak için yeniden yazabilir. Zamanlayıcıyla oyun oynamak genellikle, zamanlayıcıyı size adil alandan fazlasını vermesi için kandırmak için sinsi bir şey yapma fikrini ifade eder.

Tanımadığı algoritma şu saldırıya açıktır: zaman dilimi bitmeden önce bir G/Ç işlemi gerçekleştirin (önemsemediğiniz bir dosyaya) ve böylece CPU'yu bırakın; bunu yapmak aynı kuyrukta kalmamızı ve böylece CPU zamanın daha yüksek bir yüzdesini kazanmamızı sağlar. Doğru yapıldığında (örneğin, CPU'yu bırakmadan önce bir zaman diliminin %99'u boyunca çalışarak), bir iş CPU'yu neredeyse tekelleştirebilir.

Son olarak, bir program zaman içinde **davranışını değiştirebilir (change its behavior)**; CPU'ya bağlı olan bir iş etkileşimli bir aşamaya geçebilir. Mevcut yaklaşımımızla, böyle bir iş şanssız olacak ve sistemdeki diğer etkileşimli işler gibi ele alınamayacaktır.

İPUCU: ZAMANLAMA SALDIRILARA KARŞI GÜVENLİ OLMALI

İşletim sisteminin kendi içinde (burda tartışıldığı gibi) ve daha geniş bir bağlamda (örneğin, dağıtılmış bir depolama sisteminin G/Ç isteği işleme [Y+ 18]) bir zamanlama politikasının bir **güvenlik(security)** sorunu olmadığını düşünebilirsiniz, ancak giderek artan birçok durumda, tam olarak budur. Dünyanın dört bir yanında kullanıcıların CPU'ları, bellekleri ağları ve depolama sistemlerini paylaştığı modern veri merkezini düşünün; Politika tasarımı ve uygulamasına özen göstermeden, tek bir kullanıcı başkalarına zarar verebilir ve kendisi için avantaj sağlayabilir. Bu nedenle, zamanlama politikası bir sistemin güvenliğinin önemli bir parçasını oluşturur ve dikkatli bir şekilde oluşturulmalıdır.

Şekil 8.6: **Oyun Toleranssız (Sol) ve Oyun Toleranslı (Sağ)**

8.3 Deneme #2: Öncelik Artışı

Kuralları değiştirmeyi deneyelim ve açlık sorununu önleyip önleyemeyeceğimize bakalım. CPU'ya bağlı işlerin (çok fazla olmasa bile) bir miktar ilerleme kaydedeceğini garanti etmek için ne yapabiliriz?
Burdaki basit fikir, sistemdeki tüm işlerin önceliğini periyodik olarak **artırmaktır(boost).** Bunu başarmanın birçok yolu var ama basit bir şey yapalım: hepsini en üst sıraya atalım; Bu nedenle, yeni bir kural:

- **Kural 5:** Belirli bir S süresinden sonra, sistemdeki tüm işleri en üst kuyruğa taşıyın.

Yeni kuralımız aynı anda iki sorunu çözmektedir. İlk olarak, süreçlerin aç kalmaması garanti altına alınıyor: bir iş en üst sırada yer alarak CPU'yu diğer yüksek öncelikli işlerle round-robin şeklinde paylaşacak ve böylece eninde sonunda hizmet alacak. İkinci olarak, CPU'ya bağlı bir iş etkileşimli hale gelmişse, öncelik artışını aldıktan sonra zamanlayıcı ona uygun şekilde davranır.

Bir örnek görelim. Bu seneryoda, uzun süre çalışan bir işin, kısa süre çalışan. iki etkileşimli isle CPU için rekabet ederken nasıl davrandığını gösteriyoruz. Şekil 8.5'te (sayfa 6) iki grafik gösterilmektedir. Solda, öncelik artışı yoktur ve bu nedenle iki kısa iş geldiğinde uzun süredir çalışan iş aç kalır; sağda, her 50ms'de bir öncelik artışı vardır (bu muhtemelen çok küçük bir değerdir, ancak burada örnek için kullanılmıştır) ve bu nedenle en azından uzun süredir çalışan işin biraz ilerleme kaydedeceğini, her 50 ms'de bir en yüksek önceliğe yükseltileceğini ve böylece periyodik olarak çalışacağını garanti ederiz.

Tabii ki, S periyodunun eklenmesi bariz bir soruna yol açmaktadır: S neye ayarlanmalıdır? Saygın bir araştırmacı olan John Ousterhout [O11], sistemdeki bu tür değerleri **voo-doo sabitleri (voo-doo constants)** olarak adlandırdı çünkü onları doğru ayarlamak için bir tür kara büyü gerektiriyor gibi görünüyorlardı. Ne yazık ki, S'nin böyle bir özelliği vardır. Çok yüksek ayarlanırsa, uzun süre çalışan işler aç kalabilir; çok düşük ayarlanırsa, etkileşimli işler CPU'dan uygun bir pay alabilir.

Şekil 8.7: **Daha Düşük Öncelik, Daha Uzun Quanta**

8.4 Deneme #3: Daha İyi Hasaplama

Şimdi çözmemiz gereken bir sorun daha var: programlayıcımızın oyun oynamasını nasıl önleyebiliriz? Burdaki asıl suçlu, tahmin edebileceğiniz gibi bir işin zaman dilimi sona ermeden CPU'dan vazgeçerek önceliğini korumasına izin veren Kural 4a ve 4b'dir. Peki ne yapmalıyız?

Burdaki çözüm, MLFQ'nun her seviyesinde CPU zamanını daha iyi **hesaplamaktadır(accounting).** Bir sürecin belirli bir seviyede ne kadar zaman dilimini kullandığını unutmak yerine, programlayıcı takip etmelidir; bir süreç kendisine ayrılan süreyi kullandığında, bir sonraki öncelik sırasına indirilir. Zaman dilimini uzun bir patlamada mı yoksa birçok küçük patlamada mı kullandığı önemli değildir. Bu nedenle, Kural 4a ve 4b'yi aşağıdaki tek kurala göre yeniden yazıyoruz:

- **Kural 4:** Bir iş, belirili bir düzeyde kendisine ayrılan zamanı kullandığında (CPU'dan kaç kez vazgeçtiğine bakmalısınız), önceliği azaltılır (yani, bir kuyruktan aşağı iner)

Bir örneğe bakalım. Şekil 8.6 (sayfa7), bir iş yükü eski Kural 4a ve 4b (solda) ve yeni oyun karşıtı Kural 4 ile zamanlayıcı oyun oynamaya çalıştığında neler olduğunu göstermektedir. Oyun oynamaya karşı herhangi bir koruma olmadan, bir işlem bir zaman dilimi bitmeden hemen önce bir G/Ç yayınlayabilir ve böylece CPU zamanına hükmedebilir. Bu tür korumalar mevcut olduğunda, sürecin G/Ç davranışı ne olursa olsun, kuyruklarda yavaşça aşağı doğru hareket eder ve böylece CPU'dan haksız bir pay alamaz.

8.5 MLFQ'nun Ayarlanması ve Diğer Sorunlar

MLFQ planlamasıyla ilgili birkaç sorun daha ortaya çıkıyor. Büyük bir soru, böyle bir zamanlayıcının nasıl **parametrelendirileceğidir(parametrize).** Örneğin, kaç kuyruk olmalıdır? Kuyruk başına zaman dilimi ne kadar büyük olmalıdır? Açlıktan kaçınmak ve davranış değişikliklerini hesaba katmak için öncelik ne sıklıkla arttırılmalıdır? Bu soruların kolay yanıtları yoktur ve bu nedenle, yalnızca iş yükleri ve ardından programlayıcının ayarlanmasıyla ilgili bazı deneyimler tatmin edici bir dengeye yol açacaktır.

İPUCU: VOO-DOO SABİTLERİNDEN KAÇININ
(OUSTERHOUT YASASI)

Mümkün olduğunca voo-doo sabitlerinden kaçınmak için iyi bir fikirdir. Ne yazık ki, yukarıdaki örnekte olduğu gibi bu genellikle zordur. Sistemin iyi bir değer öğrenmesi sağlanmaya çalışılabilir ancak bu da kolay değildir. Sıklıkla ortaya çıkan sonuç: deneyimli bir yöneticinin bir şeyler doğru çalışmadığında değiştirebileceği varsayılan parametre değerleriyle dolu bir yapılandırma dosyasıdır. Tahmin edebileceğiniz gibi bunlar genellikle değiştirilmeden bırakılır ve böylece varsayılanların sahada iyi çalışmasını ummak zorunda kalırız. Bu ipucu size eski işletim sistemi profesörümüz John Ousterhout tarafından getirilmiştir. Dolayısıyla buna **Ousterhout's Kanunu (Ousterhout's Law)** diyoruz.

Örneğin, çoğu MLFQ varyantı farklı kuyruklar arasında değişen zaman dilimi uzunluğuna izin verir. Yüksek öncelikli kuyruklara genellikle kısa zaman dilimleri verilir. Sonuçta etkileşimli işlerden oluşurlar ve bu nedenle aralarında hızlı bir şekilde geçiş yapmak mantıklıdır (örneğin, 10 veya daha az milisaniye). Buna karşın düşük öncelikli kuyruklar, CPU'ya bağlı uzun soluklu işler içerir; dolayısıyla daha uzun zaman dilimleri işe yarar (örneğin 100'lerce milisaniye). Şekil 8.7 (sayfa 8), iki işin en yüksek kuyrukta 20 ms (10 ms'lik zaman dilimiyle), ortada 40ms (20ms'lik zaman dilimiyle) ve en altta 40ms'lik zaman dilimiyle çalıştığı bir örneği göstermektedir.

Solaris MLFQ uygulamasının -Zaman Paylaşımlı Zamanlama sınıfı veya TS- yapılandırılması özellikle kolaydır; bir işlemin önceliğinin ömür boyunca tam olarak nasıl değiştirileceğini, her bir zaman diliminin ne kadar uzun olduğunu ve bir işin önceliğinin ne sıklıkla arttırılacağını belirleyen bir dizi tablo sağlar [AD00]; bir yönetici, zamanlayıcının farklı şekillerde davranmasını sağlamak için bu tabloyla oynayabilir. Tablo için varsayılan değerler 60 kuyruk, 20 milisaniyeden (en yüksek öncelik) birkaç yüz milisaniyeye (en düşük) kadar yavaşça artan zaman dilimi uzunlukları ve yaklaşık her 1 saniyede bir arttırılan önceliklerdir.

Diğer MLFQ zamanlayıcıları bir tablo ya da bu bölümde açıklanan kesin kuralları kullanmazlar; bunun yerine matematiksel formülü kullanarak öncelikleri ayarlarlar. Örneğin, FreeBSD zamanlayıcısı (sürüm 4.3) bir işin mevcut öncelik seviyesini hesaplamak için bir formül kullanır ve bu sürecin ne kadar CPU kullandığına dayandırır [LM+89]; ayrıca, kullanım zaman içinde azalır ve istenilen öncelik artışını açıklanandan farklı bir şekilde sağlar. Bu arada bu tür **çürüme kullanım(decay-usage)** algoritmalarına ve özelliklerine mükemmel bir genel bakış için Epema'nın makalesine bakınız [E95].

Son olarak, birçok programlayıcının karşılaşabileceğiniz birkaç özelliği daha vardır. Örneğin, bazı planlayıcılar en yüksek öncelik düzeylerini işletim sistemi çalışması için ayırır; bu nedenle, tipik kullanıcı işleri hiçbir zaman sistemdeki en yüksek öncelik düzeylerini elde edemez. Bazı sistemler, önceliklerin belirlenmesine yardımcı olmak için bazı kullanıcı **tavsiyelerine(advice)** de izin verir; örneğin, komut satırı yardımcı programını kullanarak *iyi(nice)* bir işin önceliğini (biraz) artırabilir veya azaltılabilir ve böylece herhangi bir zamanda çalışma şansını arttırabilir veya azaltabilirsiniz. Daha fazlası için man sayfasına bakın.

İPUCU: MÜMKÜN OLAN YERLERDE TAVSİYE KULLANIN

İşletim sistemi, sistemin her bir işlemi için neyin en iyi olduğunu nadiren bildiğinden, kullanıcıların veya yöneticilerin işletim sistemine bazı **ipuçları(hints)** vermesine olanak tanıyan arayüzler sağlamak genellikle yararlıdır. Bu tür ipuçlarını genellikle **tavsiye(advice)** olarak adlandırırız. Çünkü işletim sisteminin buna mutlaka dikkat etmesi gerekmez ancak daha iyi bir karar vermek için tavsiye dikkate alabilir. Bu tür ipuçları, zamanlayıcı da dahil olmak üzere işletim sisteminin birçok bölümünde kullanışlıdır (örneğin *nice* ile), bellek yöneticisi (örneğin *madvise*), ve dosya sistemi (örneğin, bilgilendirilmiş ön getirme ve önbellekleme[P+95]).

8.6 MLFQ: Özet

Çok Seviyeli Geri Bildirim Kuyruğu (MLFQ) olarak bilinen bir zamanlama yaklaşımını tanımladık. Umarım şimdi neden böyle adlandırıldığını anlayabilirsiniz: *birden fazla kuyruk seviyesi (multi levels of queues)* vardır ve belirli bir iş önceliğini belirlemek için *geri bildirim(feedback)* kullanır. Tarih onun rehberidir: işlerin zaman içinde nasıl davrandığına dikkat edin ve onlara uygun şekilde davranın.

Bölümün tamamına yayılan rafine MLFQ kuralları seti, izleme zevkiniz için burada yeniden üretilmiştir:

- **Kural 1:** Öncelik(A)> Öncelik(B) ise, A çalışır (B çalışmaz).
- **Kural 2:** Öncelik(A) = Öncelik(B) İse, A ve B verilen kuyruğun zaman dilimini (kuantum uzunluğu) kullanarak round-robin hızında çalışır.
- **Kural 3:** Bir iş sisteme girdiğinde, en yüksek önceliğe yerleştirilir (en üst kuyruk).
- **Kural 4:** Bir iş, belirli bir düzeyde (CPU'dan kaç kez vazgeçtiğine bakılmaksızın) ayrılan süreyi kullandığında, önceliği azaltır (yani bir sıra aşağıya iner).
- **Kural 5:** Belirli bir S süresinden sonra, sistemdeki tüm işleri en üst kuyruğa taşıyın.

MLFQ aşağıdaki nedenden dolayı ilginçtir. Bir işin doğası hakkında önceden *(a priori)* bilgi talep etmek yerine, bir işin yürütülmesini gözlemler ve ona göre öncelik verir. Bu şekilde, her iki dünyanın da en iyisini elde etmeyi başarır: kısa süreli etkileşimli işler için mükemmel genel performans (SJF/STCF'ye benzer) sağlayabilir ve adildir ve uzun süreli CPU yoğun iş yükleri için ilerleme sağlar. Bu nedenle, BSD UNIX türevleri [LM+89, B86], Solaris [M06] ve Windows NT ve sonraki Windows işletim sistemleri [CS97] dahil birçok sistem, temel zamanlayıcı olarak bir MLFQ biçimi kullanır.

Referanslar

[AD00] "Multilevel Feedback Queue Scheduling in Solaris" by Andrea Arpaci-Dusseau. Avail- able: http://www.ostep.org/Citations/notes-solaris.pdf. *A great short set of notes by one of the authors on the details of the Solaris scheduler. OK, we are probably biased in this description, but the notes are pretty darn good.*

[B86] "The Design of the UNIX Operating System" by M.J. Bach. Prentice-Hall, 1986. *One of the classic old books on how a real* UNIX *operating system is built; a definite must-read for kernel hackers.*

[C+62] "An Experimental Time-Sharing System" by F. J. Corbato, M. M. Daggett, R. C. Daley. IFIPS 1962. *A bit hard to read, but the source of many of the first ideas in multi-level feedback schedul- ing. Much of this later went into Multics, which one could argue was the most influential operating system of all time.*

[CS97] "Inside Windows NT" by Helen Custer and David A. Solomon. Microsoft Press, 1997. *The NT book, if you want to learn about something other than* UNIX. *Of course, why would you? OK, we're kidding; you might actually work for Microsoft some day you know.*

[E95] "An Analysis of Decay-Usage Scheduling in Multiprocessors" by D.H.J. Epema. SIG- METRICS '95. *A nice paper on the state of the art of scheduling back in the mid 1990s, including a good overview of the basic approach behind decay-usage schedulers.*

[LM+89] "The Design and Implementation of the 4.3BSD UNIX Operating System" by S.J. Lef- fler, M.K. McKusick, M.J. Karels, J.S. Quarterman. Addison-Wesley, 1989. *Another OS classic, written by four of the main people behind BSD. The later versions of this book, while more up to date, don't quite match the beauty of this one.*

[M06] "Solaris Internals: Solaris 10 and OpenSolaris Kernel Architecture" by Richard Mc- Dougall. Prentice-Hall, 2006. *A good book about Solaris and how it works.*

[O11] "John Ousterhout's Home Page" by John Ousterhout. `www.stanford.edu/~ouster/`. *The home page of the famous Professor Ousterhout. The two co-authors of this book had the pleasure of taking graduate operating systems from Ousterhout while in graduate school; indeed, this is where the two co-authors got to know each other, eventually leading to marriage, kids, and even this book. Thus, you really can blame Ousterhout for this entire mess you're in.*

[P+95] "Informed Prefetching and Caching" by R.H. Patterson, G.A. Gibson, E. Ginting, D. Stodolsky, J. Zelenka. SOSP '95, Copper Mountain, Colorado, October 1995. *A fun paper about some very cool ideas in file systems, including how applications can give the OS advice about what files it is accessing and how it plans to access them.*

[Y+18] "Principled Schedulability Analysis for Distributed Storage Systems using Thread Ar- chitecture Models" by Suli Yang, Jing Liu, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci- Dusseau. OSDI '18, San Diego, California. *A recent work of our group that demonstrates the difficulty of scheduling I/O requests within modern distributed storage systems such as Hive/HDFS, Cassandra, MongoDB, and Riak. Without care, a single user might be able to monopolize system re- sources.*

Ödev (Simülasyon)

Bu program, *mlfq.py*, bu bölümde sunulan MLFQ zamanlayıcısının nasıl çalıştığını görmenizi sağlar. Ayrıntılar için README'ye bakın.

Questions

1. Sadece iki iş ve iki kuyruk ile rastgele oluşturulmuş birkaç problem çalıştırın; her biri için MLFQ yürütme izini hesaplayın. Her işin uzunluğunu sınırlandırarak ve G/Ç'leri kapatarak hayatınızı kolaylaştırın.

   -M bir işin maksimium G/Ç sıklığıdır bunu kapatmak için 0 değerini veriyoruz.

   -n MLFQ'nun kuyruk sayısıdır= 2

   -j sistemdeki iş sayısıdır=2

   -c cevapaları hesaplama komutudur.

   . /mlfq.py -j 2 - n 2 -M 0 -c komutunu çalıştırırsak.

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -j 2 -n 2
-M 0 -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 2
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 5
OPTIONS stayAfterIO False
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime  84 - ioFreq   0
  Job  1: startTime   0 - runTime  42 - ioFreq   0
```

   İşe giriş listesinde iş 2 ve kuyruk 2 değerini alır.

   Kuyruk kuantum uzunluğu 1-10 arasında

   Her iş için üç tanımlayıcı özellik verilir: startTime, runTime, ioFreg.

   İş Listesi:

   0. İş için startTime=0, runTime=84, ioFreq=0
   1. İş için startTime=0, runTime=42, ioFreg=0

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] JOB BEGINS by JOB 1
[ time 0 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 83 (of 84) ]
[ time 1 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 82 (of 84) ]
[ time 2 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 81 (of 84) ]
[ time 3 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 80 (of 84) ]
[ time 4 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 79 (of 84) ]
[ time 5 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 78 (of 84) ]
[ time 6 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 77 (of 84) ]
[ time 7 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 76 (of 84) ]
[ time 8 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 75 (of 84) ]
[ time 9 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 74 (of 84) ]
[ time 10 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 41 (of 42) ]
[ time 11 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 40 (of 42) ]
[ time 12 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 39 (of 42) ]
[ time 13 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 38 (of 42) ]
[ time 14 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 37 (of 42) ]
[ time 15 ] Run JOB 1 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 36 (of 42) ]
[ time 16 ] Run JOB 1 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 35 (of 42) ]
[ time 17 ] Run JOB 1 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 34 (of 42) ]
[ time 18 ] Run JOB 1 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 33 (of 42) ]
[ time 19 ] Run JOB 1 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 32 (of 42) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 73 (of 84) ]
```

İş 0 ve 1 için başlar.

Iş 0 Kuantum uzunluğu kadar öncelik 1 için çaştırılır.

İş 0 bittiğinde iş 1 Kuantum uzunluğu kadar öncelik 1‘de çalıştırılır.

Işlem bittiğinde iş kuantum uzunluğu kadar öncelik 0 ‘da çalıştırılır.

Iş 0 bittiğinde iş 1 kuantum uzunluğu kadar öncelik 0’da çalıştırılır.

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 72 (of 84) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 71 (of 84) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 70 (of 84) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 69 (of 84) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 68 (of 84) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 67 (of 84) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 66 (of 84) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 65 (of 84) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 64 (of 84) ]
[ time 30 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 31 (of 42) ]
[ time 31 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 30 (of 42) ]
[ time 32 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 29 (of 42) ]
[ time 33 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 28 (of 42) ]
[ time 34 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 27 (of 42) ]
[ time 35 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 26 (of 42) ]
[ time 36 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 25 (of 42) ]
[ time 37 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 24 (of 42) ]
[ time 38 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 23 (of 42) ]
[ time 39 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 22 (of 42) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 63 (of 84) ]
[ time 41 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 62 (of 84) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 61 (of 84) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 60 (of 84) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 59 (of 84) ]
```

Bu işlem çalışma zamanı bitinceye kadar devam eder.

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 58 (of 84) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 57 (of 84) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 56 (of 84) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 55 (of 84) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 54 (of 84) ]
[ time 50 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 21 (of 42) ]
[ time 51 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 20 (of 42) ]
[ time 52 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 19 (of 42) ]
[ time 53 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 18 (of 42) ]
[ time 54 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 17 (of 42) ]
[ time 55 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 16 (of 42) ]
[ time 56 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 15 (of 42) ]
[ time 57 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 14 (of 42) ]
[ time 58 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 13 (of 42) ]
[ time 59 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 12 (of 42) ]
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 53 (of 84) ]
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 52 (of 84) ]
[ time 62 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 51 (of 84) ]
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 50 (of 84) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 49 (of 84) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 48 (of 84) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 47 (of 84) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 46 (of 84) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 45 (of 84) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 44 (of 84) ]
[ time 70 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 11 (of 42) ]
[ time 71 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 10 (of 42) ]
[ time 72 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 9 (of 42) ]
[ time 73 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 8 (of 42) ]
[ time 74 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 7 (of 42) ]
[ time 75 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 6 (of 42) ]
[ time 76 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 5 (of 42) ]
[ time 77 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 4 (of 42) ]
[ time 78 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 3 (of 42) ]
[ time 79 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 2 (of 42) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 43 (of 84) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 42 (of 84) ]
[ time 82 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 41 (of 84) ]
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 40 (of 84) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 39 (of 84) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 38 (of 84) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 37 (of 84) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 36 (of 84) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 35 (of 84) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 34 (of 84) ]
[ time 90 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 1 (of 42) ]
[ time 91 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 0 (of 42) ]
[ time 92 ] FINISHED JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 91 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 0 (of 42) ]
[ time 92 ] FINISHED JOB 1
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 33 (of 84) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 32 (of 84) ]
[ time 94 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 31 (of 84) ]
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 30 (of 84) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 29 (of 84) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 28 (of 84) ]
[ time 98 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 27 (of 84) ]
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 26 (of 84) ]
[ time 100 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 25 (of 84) ]
[ time 101 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 24 (of 84) ]
[ time 102 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 23 (of 84) ]
[ time 103 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 22 (of 84) ]
[ time 104 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 21 (of 84) ]
[ time 105 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 20 (of 84) ]
[ time 106 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 19 (of 84) ]
[ time 107 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 18 (of 84) ]
[ time 108 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 17 (of 84) ]
[ time 109 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 16 (of 84) ]
[ time 110 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 15 (of 84) ]
[ time 111 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 14 (of 84) ]
[ time 112 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 13 (of 84) ]
[ time 113 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 12 (of 84) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 112 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 13 (of 84) ]
[ time 113 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 12 (of 84) ]
[ time 114 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 11 (of 84) ]
[ time 115 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 10 (of 84) ]
[ time 116 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 9 (of 84) ]
[ time 117 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 8 (of 84) ]
[ time 118 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 7 (of 84) ]
[ time 119 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 6 (of 84) ]
[ time 120 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 5 (of 84) ]
[ time 121 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 4 (of 84) ]
[ time 122 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 3 (of 84) ]
[ time 123 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 2 (of 84) ]
[ time 124 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 1 (of 84) ]
[ time 125 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 0 (of 84) ]
[ time 126 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 126
  Job  1: startTime   0 - response  10 - turnaround  92

  Avg  1: startTime n/a - response 5.00 - turnaround 109.00

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

Iş 0'ın geri dönüş süresi(turnaround)=126

Iş 1'in geri dönüş süresi(turnaround)=92

Turnarounad= (126+92)/2=109

Iş 0 için yanıt(response)=0

Iş 1 için yanıt(response)=10

Response= (0+10)/2=5

2. Bu bölümdeki örneklerin her birini yeniden oluşturmak için zamanlayıcıyı nasıl çalıştırıdınız?

// Şekil 8.2

-n MLFQ'nun kuyruk sayısıdır= 3.
-j listedeki iş sayısıdır = 1 iş.
-q zaman dilimi uzunluğu = 10ms.
-c cevapları hesaplama komutudur.

. /mlfq.py --jlist 0,200,0 -q 10 -c

Simülatörü bu şekilde çalıştırırsak tek bir iş yapar. Her seviyede 10 ms'lik zaman dilimine sahiptir. İş 0. Zamanda başlar, toplam 200 ms çalışır ve hiç G/Ç yayınlamaz.

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py --jlist 0,200,0 -q 10 -c
Here is the list of inputs:
OPTIONS jobs 1
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 5
OPTIONS stayAfterIO False
OPTIONS ioBump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime 200 - ioFreq   0


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 199 (of 200) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 198 (of 200) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 197 (of 200) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 196 (of 200) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 195 (of 200) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 194 (of 200) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 193 (of 200) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 192 (of 200) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 191 (of 200) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 190 (of 200) ]
[ time 10 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 189 (of 200) ]
[ time 11 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 188 (of 200) ]
[ time 12 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 187 (of 200) ]
[ time 13 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 186 (of 200) ]
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 185 (of 200) ]
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 184 (of 200) ]
[ time 16 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 183 (of 200) ]
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 182 (of 200) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 181 (of 200) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 182 (of 200) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 181 (of 200) ]
[ time 19 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 180 (of 200) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 179 (of 200) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 178 (of 200) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 177 (of 200) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 176 (of 200) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 175 (of 200) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 174 (of 200) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 173 (of 200) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 172 (of 200) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 171 (of 200) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 170 (of 200) ]
[ time 30 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 169 (of 200) ]
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 168 (of 200) ]
[ time 32 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 167 (of 200) ]
[ time 33 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 166 (of 200) ]
[ time 34 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 165 (of 200) ]
[ time 35 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 164 (of 200) ]
[ time 36 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 163 (of 200) ]
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 162 (of 200) ]
[ time 38 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 161 (of 200) ]
[ time 39 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 160 (of 200) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 159 (of 200) ]
[ time 41 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 158 (of 200) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 157 (of 200) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 156 (of 200) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 155 (of 200) ]
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 154 (of 200) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 153 (of 200) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 152 (of 200) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 151 (of 200) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 150 (of 200) ]
[ time 50 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 149 (of 200) ]
[ time 51 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 148 (of 200) ]
[ time 52 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 147 (of 200) ]
[ time 53 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 146 (of 200) ]
[ time 54 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 145 (of 200) ]
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 144 (of 200) ]
[ time 56 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 143 (of 200) ]
[ time 57 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 142 (of 200) ]
[ time 58 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 141 (of 200) ]
[ time 59 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 140 (of 200) ]
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 139 (of 200) ]
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 138 (of 200) ]
[ time 62 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 137 (of 200) ]
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 136 (of 200) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 135 (of 200) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 134 (of 200) ]
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 134 (of 200) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 133 (of 200) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 132 (of 200) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 131 (of 200) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 130 (of 200) ]
[ time 70 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 129 (of 200) ]
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 128 (of 200) ]
[ time 72 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 127 (of 200) ]
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 126 (of 200) ]
[ time 74 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 125 (of 200) ]
[ time 75 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 124 (of 200) ]
[ time 76 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 123 (of 200) ]
[ time 77 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 122 (of 200) ]
[ time 78 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 121 (of 200) ]
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 120 (of 200) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 119 (of 200) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 118 (of 200) ]
[ time 82 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 117 (of 200) ]
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 116 (of 200) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 115 (of 200) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 114 (of 200) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 113 (of 200) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 112 (of 200) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 111 (of 200) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 110 (of 200) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 109 (of 200) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 108 (of 200) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 107 (of 200) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 106 (of 200) ]
[ time 94 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 105 (of 200) ]
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 104 (of 200) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 103 (of 200) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 102 (of 200) ]
[ time 98 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 101 (of 200) ]
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 100 (of 200) ]
[ time 100 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 99 (of 200) ]
[ time 101 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 98 (of 200) ]
[ time 102 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 97 (of 200) ]
[ time 103 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 96 (of 200) ]
[ time 104 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 95 (of 200) ]
[ time 105 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 94 (of 200) ]
[ time 106 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 93 (of 200) ]
[ time 107 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 92 (of 200) ]
[ time 108 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 91 (of 200) ]
[ time 109 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 90 (of 200) ]
[ time 110 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 89 (of 200) ]
[ time 111 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 88 (of 200) ]
[ time 112 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 87 (of 200) ]
[ time 113 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 86 (of 200) ]
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 115 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 84 (of 200) ]
[ time 116 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 83 (of 200) ]
[ time 117 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 82 (of 200) ]
[ time 118 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 81 (of 200) ]
[ time 119 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 80 (of 200) ]
[ time 120 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 79 (of 200) ]
[ time 121 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 78 (of 200) ]
[ time 122 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 77 (of 200) ]
[ time 123 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 76 (of 200) ]
[ time 124 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 75 (of 200) ]
[ time 125 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 74 (of 200) ]
[ time 126 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 73 (of 200) ]
[ time 127 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 72 (of 200) ]
[ time 128 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 71 (of 200) ]
[ time 129 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 70 (of 200) ]
[ time 130 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 69 (of 200) ]
[ time 131 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 68 (of 200) ]
[ time 132 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 67 (of 200) ]
[ time 133 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 66 (of 200) ]
[ time 134 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 65 (of 200) ]
[ time 135 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 64 (of 200) ]
[ time 136 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 63 (of 200) ]
[ time 137 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 62 (of 200) ]
[ time 138 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 61 (of 200) ]
[ time 139 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 60 (of 200) ]
[ time 140 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 59 (of 200) ]
[ time 141 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 58 (of 200) ]
[ time 142 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 57 (of 200) ]
[ time 143 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 56 (of 200) ]
[ time 144 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 55 (of 200) ]
[ time 145 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 54 (of 200) ]
[ time 146 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 53 (of 200) ]
[ time 147 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 52 (of 200) ]
[ time 148 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 51 (of 200) ]
[ time 149 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 50 (of 200) ]
[ time 150 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 49 (of 200) ]
[ time 151 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 48 (of 200) ]
[ time 152 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 47 (of 200) ]
[ time 153 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 46 (of 200) ]
[ time 154 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 45 (of 200) ]
[ time 155 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 44 (of 200) ]
[ time 156 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 43 (of 200) ]
[ time 157 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 42 (of 200) ]
[ time 158 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 41 (of 200) ]
[ time 159 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 40 (of 200) ]
[ time 160 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 200) ]
[ time 161 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 200) ]
[ time 162 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 200) ]
[ time 163 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 200) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 159 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 40 (of 200) ]
[ time 160 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 200) ]
[ time 161 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 200) ]
[ time 162 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 200) ]
[ time 163 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 200) ]
[ time 164 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 200) ]
[ time 165 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 200) ]
[ time 166 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 200) ]
[ time 167 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 200) ]
[ time 168 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 200) ]
[ time 169 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 200) ]
[ time 170 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 200) ]
[ time 171 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 200) ]
[ time 172 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 200) ]
[ time 173 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 200) ]
[ time 174 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 200) ]
[ time 175 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 200) ]
[ time 176 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 200) ]
[ time 177 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 200) ]
[ time 178 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 200) ]
[ time 179 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 200) ]
[ time 180 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 200) ]
[ time 181 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 200) ]
[ time 182 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 200) ]
[ time 183 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 200) ]
[ time 184 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 200) ]
[ time 185 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 200) ]
[ time 186 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 200) ]
[ time 187 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 200) ]
[ time 188 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 200) ]
[ time 189 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 200) ]
[ time 190 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 200) ]
[ time 191 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 200) ]
[ time 192 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 200) ]
[ time 193 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 200) ]
[ time 194 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 200) ]
[ time 195 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 200) ]
[ time 196 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 200) ]
[ time 197 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 200) ]
[ time 198 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 200) ]
[ time 199 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 200) ]
[ time 200 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 200

  Avg  0: startTime n/a - response 0.00 - turnaround 200.00
```

Sonuçtan da görüldüğü gibi iş 0'ın başlama zamanı 0 geri dönüş süresi(turnround) 200 ms'dir.

//Şekil 8.3

Simulatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ oluşturur ve her 10 ms 'lik zaman dilimine sahiptir. İki iş oluşturur. İş 0, 0 zamanda başlar, toplam 200 ms çalışır ve hiç G/Ç yayınlamaz; İş 1, 100 ms'de başlar, tamamlanması için 30 ms CPU süresine ihtiyaç duyar ve ayrıca hiç G/Ç yayınlamaz.

-n MLFQ kuyruk sayısı =3
-j listedeki iş sayısı=2
-q zaman dilim uzunluğu= 10
-c cevaplama hesaplama komutu.

. /mlfq.py – jlist 0,200,0:100,30,0 -q 10 -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py --jlist 0,200,0
:100,30,0 -q 10 -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 5
OPTIONS stayAfterIO False
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime 200 - ioFreq   0
  Job  1: startTime 100 - runTime  30 - ioFreq   0


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 199 (of 200) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 198 (of 200) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 197 (of 200) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 196 (of 200) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 195 (of 200) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 194 (of 200) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 193 (of 200) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 192 (of 200) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 191 (of 200) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 190 (of 200) ]
[ time 10 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 189 (of 200) ]
[ time 11 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 188 (of 200) ]
[ time 12 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 187 (of 200) ]
[ time 13 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 186 (of 200) ]
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 185 (of 200) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 185 (of 200) ]
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 184 (of 200) ]
[ time 16 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 183 (of 200) ]
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 182 (of 200) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 181 (of 200) ]
[ time 19 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 180 (of 200) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 179 (of 200) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 178 (of 200) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 177 (of 200) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 176 (of 200) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 175 (of 200) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 174 (of 200) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 173 (of 200) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 172 (of 200) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 171 (of 200) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 170 (of 200) ]
[ time 30 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 169 (of 200) ]
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 168 (of 200) ]
[ time 32 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 167 (of 200) ]
[ time 33 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 166 (of 200) ]
[ time 34 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 165 (of 200) ]
[ time 35 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 164 (of 200) ]
[ time 36 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 163 (of 200) ]
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 162 (of 200) ]
[ time 38 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 161 (of 200) ]
[ time 39 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 160 (of 200) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 159 (of 200) ]
[ time 41 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 158 (of 200) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 157 (of 200) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 156 (of 200) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 155 (of 200) ]
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 154 (of 200) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 153 (of 200) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 152 (of 200) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 151 (of 200) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 150 (of 200) ]
[ time 50 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 149 (of 200) ]
[ time 51 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 148 (of 200) ]
[ time 52 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 147 (of 200) ]
[ time 53 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 146 (of 200) ]
[ time 54 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 145 (of 200) ]
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 144 (of 200) ]
[ time 56 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 143 (of 200) ]
[ time 57 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 142 (of 200) ]
[ time 58 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 141 (of 200) ]
[ time 59 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 140 (of 200) ]
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 139 (of 200) ]
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 138 (of 200) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 138 (of 200) ]
[ time 62 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 137 (of 200) ]
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 136 (of 200) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 135 (of 200) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 134 (of 200) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 133 (of 200) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 132 (of 200) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 131 (of 200) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 130 (of 200) ]
[ time 70 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 129 (of 200) ]
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 128 (of 200) ]
[ time 72 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 127 (of 200) ]
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 126 (of 200) ]
[ time 74 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 125 (of 200) ]
[ time 75 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 124 (of 200) ]
[ time 76 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 123 (of 200) ]
[ time 77 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 122 (of 200) ]
[ time 78 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 121 (of 200) ]
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 120 (of 200) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 119 (of 200) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 118 (of 200) ]
[ time 82 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 117 (of 200) ]
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 116 (of 200) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 115 (of 200) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 114 (of 200) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 113 (of 200) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 112 (of 200) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 111 (of 200) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 110 (of 200) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 109 (of 200) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 108 (of 200) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 107 (of 200) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 106 (of 200) ]
[ time 94 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 105 (of 200) ]
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 104 (of 200) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 103 (of 200) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 102 (of 200) ]
[ time 98 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 101 (of 200) ]
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 100 (of 200) ]
[ time 100 ] JOB BEGINS by JOB 1
[ time 100 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 29 (of 30) ]
[ time 101 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 28 (of 30) ]
[ time 102 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 27 (of 30) ]
[ time 103 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 26 (of 30) ]
[ time 104 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 25 (of 30) ]
[ time 105 ] Run JOB 1 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 24 (of 30) ]
[ time 106 ] Run JOB 1 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 23 (of 30) ]
[ time 107 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 22 (of 30) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 107 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 22 (of 30) ]
[ time 108 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 21 (of 30) ]
[ time 109 ] Run JOB 1 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 20 (of 30) ]
[ time 110 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 19 (of 30) ]
[ time 111 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 18 (of 30) ]
[ time 112 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 17 (of 30) ]
[ time 113 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 16 (of 30) ]
[ time 114 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 15 (of 30) ]
[ time 115 ] Run JOB 1 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 14 (of 30) ]
[ time 116 ] Run JOB 1 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 13 (of 30) ]
[ time 117 ] Run JOB 1 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 12 (of 30) ]
[ time 118 ] Run JOB 1 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 11 (of 30) ]
[ time 119 ] Run JOB 1 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 10 (of 30) ]
[ time 120 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 99 (of 200) ]
[ time 121 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 98 (of 200) ]
[ time 122 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 97 (of 200) ]
[ time 123 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 96 (of 200) ]
[ time 124 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 95 (of 200) ]
[ time 125 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 94 (of 200) ]
[ time 126 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 93 (of 200) ]
[ time 127 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 92 (of 200) ]
[ time 128 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 91 (of 200) ]
[ time 129 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 90 (of 200) ]
[ time 130 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 30) ]
[ time 131 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 30) ]
[ time 132 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 30) ]
[ time 133 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 30) ]
[ time 134 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 30) ]
[ time 135 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 30) ]
[ time 136 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 30) ]
[ time 137 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 30) ]
[ time 138 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 30) ]
[ time 139 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 30) ]
[ time 140 ] FINISHED JOB 1
[ time 140 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 89 (of 200) ]
[ time 141 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 88 (of 200) ]
[ time 142 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 87 (of 200) ]
[ time 143 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 86 (of 200) ]
[ time 144 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 85 (of 200) ]
[ time 145 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 84 (of 200) ]
[ time 146 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 83 (of 200) ]
[ time 147 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 82 (of 200) ]
[ time 148 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 81 (of 200) ]
[ time 149 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 80 (of 200) ]
[ time 150 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 79 (of 200) ]
[ time 151 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 78 (of 200) ]
[ time 152 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 77 (of 200) ]
[ time 153 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 76 (of 200) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 154 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 75 (of 200) ]
[ time 155 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 74 (of 200) ]
[ time 156 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 73 (of 200) ]
[ time 157 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 72 (of 200) ]
[ time 158 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 71 (of 200) ]
[ time 159 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 70 (of 200) ]
[ time 160 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 69 (of 200) ]
[ time 161 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 68 (of 200) ]
[ time 162 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 67 (of 200) ]
[ time 163 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 66 (of 200) ]
[ time 164 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 65 (of 200) ]
[ time 165 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 64 (of 200) ]
[ time 166 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 63 (of 200) ]
[ time 167 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 62 (of 200) ]
[ time 168 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 61 (of 200) ]
[ time 169 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 60 (of 200) ]
[ time 170 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 59 (of 200) ]
[ time 171 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 58 (of 200) ]
[ time 172 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 57 (of 200) ]
[ time 173 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 56 (of 200) ]
[ time 174 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 55 (of 200) ]
[ time 175 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 54 (of 200) ]
[ time 176 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 53 (of 200) ]
[ time 177 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 52 (of 200) ]
[ time 178 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 51 (of 200) ]
[ time 179 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 50 (of 200) ]
[ time 180 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 49 (of 200) ]
[ time 181 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 48 (of 200) ]
[ time 182 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 47 (of 200) ]
[ time 183 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 46 (of 200) ]
[ time 184 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 45 (of 200) ]
[ time 185 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 44 (of 200) ]
[ time 186 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 43 (of 200) ]
[ time 187 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 42 (of 200) ]
[ time 188 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 41 (of 200) ]
[ time 189 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 40 (of 200) ]
[ time 190 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 200) ]
[ time 191 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 200) ]
[ time 192 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 200) ]
[ time 193 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 200) ]
[ time 194 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 200) ]
[ time 195 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 200) ]
[ time 196 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 200) ]
[ time 197 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 200) ]
[ time 198 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 200) ]
[ time 199 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 200) ]
[ time 200 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 200) ]
[ time 201 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 200) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 192 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 200) ]
[ time 193 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 200) ]
[ time 194 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 200) ]
[ time 195 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 200) ]
[ time 196 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 200) ]
[ time 197 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 200) ]
[ time 198 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 200) ]
[ time 199 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 200) ]
[ time 200 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 200) ]
[ time 201 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 200) ]
[ time 202 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 200) ]
[ time 203 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 200) ]
[ time 204 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 200) ]
[ time 205 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 200) ]
[ time 206 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 200) ]
[ time 207 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 200) ]
[ time 208 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 200) ]
[ time 209 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 200) ]
[ time 210 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 200) ]
[ time 211 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 200) ]
[ time 212 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 200) ]
[ time 213 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 200) ]
[ time 214 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 200) ]
[ time 215 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 200) ]
[ time 216 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 200) ]
[ time 217 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 200) ]
[ time 218 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 200) ]
[ time 219 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 200) ]
[ time 220 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 200) ]
[ time 221 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 200) ]
[ time 222 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 200) ]
[ time 223 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 200) ]
[ time 224 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 200) ]
[ time 225 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 200) ]
[ time 226 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 200) ]
[ time 227 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 200) ]
[ time 228 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 200) ]
[ time 229 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 200) ]
[ time 230 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 230
  Job  1: startTime 100 - response   0 - turnaround  40

  Avg  1: startTime n/a - response 0.00 - turnaround 135.00

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

Iş 0 için başlama zamanı 0 turnround 230
Iş 1 için başlama zamanı 100 turnround 40
Turnround= (230+40)/2= 135

// Şekil 8.4

Simulatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ oluşturur ve her 10 ms 'lik zaman dilimine sahiptir. İki iş oluşturur. İş 0, 0 zamanda başlar, toplam 150 ms çalışır ve hiç G/Ç yayınlamaz; İş 1, 50 ms'de başlar, tamamlanması için 50 ms CPU süresine ihtiyaç duyar ve ayrıca 1 G/Ç yayınlar.

-n MLFQ kuyruk sayısı =3
-j listedeki iş sayısı=2
-q zaman dilim uzunluğu= 10
-i bir G/Ç ne kadar sürmesi gerektiği(sabit)
-S G/Ç verirken sıfırlanır ve aynı öncelik seviyesinde kalır
-c cevaplama hesaplama komutu.

. /mlfq.py -n 3 -q 10 -l 0,150,0:50,1 -i 3 -S -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
bash: ./mlfq: No such file or directory
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -n 3 -q 10 -l 0,150,0:50,50,1 -i 3 -S -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 3
OPTIONS allotments for queue  2 is  1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is  1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is  1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 3
OPTIONS stayAfterIO True
OPTIONS ioDump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime 150 - ioFreq   0
  Job  1: startTime  50 - runTime  50 - ioFreq   1


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 149 (of 150) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 148 (of 150) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 147 (of 150) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 146 (of 150) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 145 (of 150) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 144 (of 150) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 143 (of 150) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 142 (of 150) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 141 (of 150) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 140 (of 150) ]
[ time 10 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 139 (of 150) ]
[ time 11 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 138 (of 150) ]
[ time 12 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 137 (of 150) ]
[ time 13 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 136 (of 150) ]
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 135 (of 150) ]
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 134 (of 150) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 134 (of 150) ]
[ time 16 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 133 (of 150) ]
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 132 (of 150) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 131 (of 150) ]
[ time 19 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 130 (of 150) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 129 (of 150) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 128 (of 150) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 127 (of 150) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 126 (of 150) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 125 (of 150) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 124 (of 150) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 123 (of 150) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 122 (of 150) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 121 (of 150) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 120 (of 150) ]
[ time 30 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 119 (of 150) ]
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 118 (of 150) ]
[ time 32 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 117 (of 150) ]
[ time 33 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 116 (of 150) ]
[ time 34 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 115 (of 150) ]
[ time 35 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 114 (of 150) ]
[ time 36 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 113 (of 150) ]
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 112 (of 150) ]
[ time 38 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 111 (of 150) ]
[ time 39 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 110 (of 150) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 109 (of 150) ]
[ time 41 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 108 (of 150) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 107 (of 150) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 106 (of 150) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 105 (of 150) ]
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 104 (of 150) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 103 (of 150) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 102 (of 150) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 101 (of 150) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 100 (of 150) ]
  time 50 ]  JOB BEGINS by JOB 1
[ time 50 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 49 (of 50) ]
[ time 51 ] IO_START by JOB 1
IO DONE
[ time 51 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 99 (of 150) ]
[ time 52 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 98 (of 150) ]
[ time 53 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 97 (of 150) ]
  time 54 ]  IO_DONE by JOB 1
[ time 54 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 48 (of 50) ]
[ time 55 ] IO_START by JOB 1
IO DONE
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 96 (of 150) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
IO DONE
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 96 (of 150) ]
[ time 56 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 95 (of 150) ]
[ time 57 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 94 (of 150) ]
[ time 58 ] IO_DONE by JOB 1
[ time 58 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 47 (of 50) ]
[ time 59 ] IO_START by JOB 1
IO DONE
[ time 59 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 93 (of 150) ]
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 92 (of 150) ]
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 91 (of 150) ]
[ time 62 ] IO_DONE by JOB 1
[ time 62 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 46 (of 50) ]
[ time 63 ] IO_START by JOB 1
IO DONE
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 90 (of 150) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 89 (of 150) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 88 (of 150) ]
[ time 66 ] IO_DONE by JOB 1
[ time 66 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 45 (of 50) ]
[ time 67 ] IO_START by JOB 1
IO DONE
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 87 (of 150) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 86 (of 150) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 85 (of 150) ]
[ time 70 ] IO_DONE by JOB 1
[ time 70 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 44 (of 50) ]
[ time 71 ] IO_START by JOB 1
IO DONE
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 84 (of 150) ]
[ time 72 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 83 (of 150) ]
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 82 (of 150) ]
[ time 74 ] IO_DONE by JOB 1
[ time 74 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 43 (of 50) ]
[ time 75 ] IO_START by JOB 1
IO DONE
[ time 75 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 81 (of 150) ]
[ time 76 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 80 (of 150) ]
[ time 77 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 79 (of 150) ]
[ time 78 ] IO_DONE by JOB 1
[ time 78 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 42 (of 50) ]
[ time 79 ] IO_START by JOB 1
IO DONE
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 78 (of 150) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 77 (of 150) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 76 (of 150) ]
[ time 82 ] IO_DONE by JOB 1
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 75 (of 150) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 74 (of 150) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 73 (of 150) ]
[ time 86 ] IO_DONE by JOB 1
[ time 86 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 40 (of 50) ]
[ time 87 ] IO_START by JOB 1
IO DONE
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 72 (of 150) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 71 (of 150) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 70 (of 150) ]
[ time 90 ] IO_DONE by JOB 1
[ time 90 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 91 ] IO_START by JOB 1
IO DONE
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 69 (of 150) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 68 (of 150) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 67 (of 150) ]
[ time 94 ] IO_DONE by JOB 1
[ time 94 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 38 (of 50) ]
[ time 95 ] IO_START by JOB 1
IO DONE
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 66 (of 150) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 65 (of 150) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 64 (of 150) ]
[ time 98 ] IO_DONE by JOB 1
[ time 98 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 37 (of 50) ]
[ time 99 ] IO_START by JOB 1
IO DONE
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 63 (of 150) ]
[ time 100 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 62 (of 150) ]
[ time 101 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 61 (of 150) ]
[ time 102 ] IO_DONE by JOB 1
[ time 102 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 36 (of 50) ]
[ time 103 ] IO_START by JOB 1
IO DONE
[ time 103 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 60 (of 150) ]
[ time 104 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 59 (of 150) ]
[ time 105 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 58 (of 150) ]
[ time 106 ] IO_DONE by JOB 1
[ time 106 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 35 (of 50) ]
[ time 107 ] IO_START by JOB 1
IO DONE
[ time 107 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 57 (of 150) ]
[ time 108 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 56 (of 150) ]
[ time 109 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 55 (of 150) ]
[ time 110 ] IO_DONE by JOB 1
[ time 110 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 34 (of 50) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 110 ] IO_DONE by JOB 1
[ time 110 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 34 (of 50) ]
[ time 111 ] IO_START by JOB 1
IO DONE
[ time 111 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 54 (of 150) ]
[ time 112 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 53 (of 150) ]
[ time 113 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 52 (of 150) ]
[ time 114 ] IO_DONE by JOB 1
[ time 114 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 33 (of 50) ]
[ time 115 ] IO_START by JOB 1
IO DONE
[ time 115 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 51 (of 150) ]
[ time 116 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 50 (of 150) ]
[ time 117 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 49 (of 150) ]
[ time 118 ] IO_DONE by JOB 1
[ time 118 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 32 (of 50) ]
[ time 119 ] IO_START by JOB 1
IO DONE
[ time 119 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 48 (of 150) ]
[ time 120 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 47 (of 150) ]
[ time 121 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 46 (of 150) ]
[ time 122 ] IO_DONE by JOB 1
[ time 122 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 31 (of 50) ]
[ time 123 ] IO_START by JOB 1
IO DONE
[ time 123 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 45 (of 150) ]
[ time 124 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 44 (of 150) ]
[ time 125 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 43 (of 150) ]
[ time 126 ] IO_DONE by JOB 1
[ time 126 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 30 (of 50) ]
[ time 127 ] IO_START by JOB 1
IO DONE
[ time 127 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 42 (of 150) ]
[ time 128 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 41 (of 150) ]
[ time 129 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 40 (of 150) ]
[ time 130 ] IO_DONE by JOB 1
[ time 130 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 131 ] IO_START by JOB 1
IO DONE
[ time 131 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 150) ]
[ time 132 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 150) ]
[ time 133 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 150) ]
[ time 134 ] IO_DONE by JOB 1
[ time 134 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 28 (of 50) ]
[ time 135 ] IO_START by JOB 1
IO DONE
[ time 135 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 150) ]
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
IO DONE
[ time 135 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 150) ]
[ time 136 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 150) ]
[ time 137 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 150) ]
[ time 138 ] IO_DONE by JOB 1
[ time 138 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 27 (of 50) ]
[ time 139 ] IO_START by JOB 1
IO DONE
[ time 139 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 150) ]
[ time 140 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 150) ]
[ time 141 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 150) ]
[ time 142 ] IO_DONE by JOB 1
[ time 142 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 26 (of 50) ]
[ time 143 ] IO_START by JOB 1
IO DONE
[ time 143 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 150) ]
[ time 144 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 150) ]
[ time 145 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 150) ]
[ time 146 ] IO_DONE by JOB 1
[ time 146 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 25 (of 50) ]
[ time 147 ] IO_START by JOB 1
IO DONE
[ time 147 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 150) ]
[ time 148 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 150) ]
[ time 149 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 150) ]
[ time 150 ] IO_DONE by JOB 1
[ time 150 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 24 (of 50) ]
[ time 151 ] IO_START by JOB 1
IO DONE
[ time 151 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 150) ]
[ time 152 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 150) ]
[ time 153 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 150) ]
[ time 154 ] IO_DONE by JOB 1
[ time 154 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 23 (of 50) ]
[ time 155 ] IO_START by JOB 1
IO DONE
[ time 155 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 150) ]
[ time 156 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 150) ]
[ time 157 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 150) ]
[ time 158 ] IO_DONE by JOB 1
[ time 158 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 22 (of 50) ]
[ time 159 ] IO_START by JOB 1
IO DONE
[ time 159 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 150) ]
[ time 160 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 150) ]
[ time 161 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 150) ]
[ time 162 ] IO_DONE by JOB 1
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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 162 ] IO_DONE by JOB 1
[ time 162 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 21 (of 50) ]
[ time 163 ] IO_START by JOB 1
IO DONE
[ time 163 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 150) ]
[ time 164 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 150) ]
[ time 165 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 150) ]
[ time 166 ] IO_DONE by JOB 1
[ time 166 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 20 (of 50) ]
[ time 167 ] IO_START by JOB 1
IO DONE
[ time 167 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 150) ]
[ time 168 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 150) ]
[ time 169 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 150) ]
[ time 170 ] IO_DONE by JOB 1
[ time 170 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 171 ] IO_START by JOB 1
IO DONE
[ time 171 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 150) ]
[ time 172 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 150) ]
[ time 173 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 150) ]
[ time 174 ] IO_DONE by JOB 1
[ time 174 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 18 (of 50) ]
[ time 175 ] IO_START by JOB 1
IO DONE
[ time 175 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 150) ]
[ time 176 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 150) ]
[ time 177 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 150) ]
[ time 178 ] IO_DONE by JOB 1
[ time 178 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 17 (of 50) ]
[ time 179 ] IO_START by JOB 1
IO DONE
[ time 179 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 150) ]
[ time 180 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 150) ]
[ time 181 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 150) ]
[ time 182 ] IO_DONE by JOB 1
[ time 182 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 16 (of 50) ]
[ time 183 ] IO_START by JOB 1
IO DONE
[ time 183 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 150) ]
[ time 184 ] FINISHED JOB 0
[ time 184 ] IDLE
[ time 185 ] IDLE
[ time 186 ] IO_DONE by JOB 1
[ time 186 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 15 (of 50) ]
[ time 187 ] IO_START by JOB 1
IO DONE
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 187 ] IO_START by JOB 1
IO DONE
[ time 187 ] IDLE
[ time 188 ] IDLE
[ time 189 ] IDLE
[ time 190 ] IO_DONE by JOB 1
[ time 190 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 14 (of 50) ]
[ time 191 ] IO_START by JOB 1
IO DONE
[ time 191 ] IDLE
[ time 192 ] IDLE
[ time 193 ] IDLE
[ time 194 ] IO_DONE by JOB 1
[ time 194 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 13 (of 50) ]
[ time 195 ] IO_START by JOB 1
IO DONE
[ time 195 ] IDLE
[ time 196 ] IDLE
[ time 197 ] IDLE
[ time 198 ] IO_DONE by JOB 1
[ time 198 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 12 (of 50) ]
[ time 199 ] IO_START by JOB 1
IO DONE
[ time 199 ] IDLE
[ time 200 ] IDLE
[ time 201 ] IDLE
[ time 202 ] IO_DONE by JOB 1
[ time 202 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 11 (of 50) ]
[ time 203 ] IO_START by JOB 1
IO DONE
[ time 203 ] IDLE
[ time 204 ] IDLE
[ time 205 ] IDLE
[ time 206 ] IO_DONE by JOB 1
[ time 206 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 10 (of 50) ]
[ time 207 ] IO_START by JOB 1
IO DONE
[ time 207 ] IDLE
[ time 208 ] IDLE
[ time 209 ] IDLE
[ time 210 ] IO_DONE by JOB 1
[ time 210 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 211 ] IO_START by JOB 1
IO DONE
[ time 211 ] IDLE
[ time 212 ] IDLE
[ time 213 ] IDLE
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 226 ] IO_DONE by JOB 1
[ time 226 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 5 (of 50) ]
[ time 227 ] IO_START by JOB 1
IO DONE
[ time 227 ] IDLE
[ time 228 ] IDLE
[ time 229 ] IDLE
[ time 230 ] IO_DONE by JOB 1
[ time 230 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 4 (of 50) ]
[ time 231 ] IO_START by JOB 1
IO DONE
[ time 231 ] IDLE
[ time 232 ] IDLE
[ time 233 ] IDLE
[ time 234 ] IO_DONE by JOB 1
[ time 234 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 3 (of 50) ]
[ time 235 ] IO_START by JOB 1
IO DONE
[ time 235 ] IDLE
[ time 236 ] IDLE
[ time 237 ] IDLE
[ time 238 ] IO_DONE by JOB 1
[ time 238 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 2 (of 50) ]
[ time 239 ] IO_START by JOB 1
IO DONE
[ time 239 ] IDLE
[ time 240 ] IDLE
[ time 241 ] IDLE
[ time 242 ] IO_DONE by JOB 1
[ time 242 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 1 (of 50) ]
[ time 243 ] IO_START by JOB 1
IO DONE
[ time 243 ] IDLE
[ time 244 ] IDLE
[ time 245 ] IDLE
[ time 246 ] IO_DONE by JOB 1
[ time 246 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 0 (of 50) ]
[ time 247 ] FINISHED JOB 1

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 184
  Job  1: startTime  50 - response   0 - turnaround 197

  Avg  1: startTime n/a - response 0.00 - turnaround 190.50

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

// Şekil 8.5

Simulatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ oluşturur ve her 10 ms 'lik zaman dilimine sahiptir. Üç iş oluşturur. İş 0, 0 zamanda başlar, toplam 150 ms CPU süresine ihtiyaç duyar ve hiç G/Ç yayınlamaz; İş 1, 100 ms'de başlar, tamamlanması için 50 ms CPU süresine ihtiyaç duyar ve ayrıca 5 G/Ç yayınlar. İş 2, 100 ms'de başlar toplam 50 ms CPU süresine ihtiyaç duyar ve 5 G/Ç yayınlar.

-n MLFQ kuyruk sayısı =3
-j listedeki iş sayısı=3
-q zaman dilim uzunluğu= 10
-i bir G/Ç ne kadar sürmesi gerektiği(sabit)= 2
-S G/Ç verirken sıfırlanır ve aynı öncelik seviyesinde kalır
-B önceliği ne sıklıkla artırmak için
-c cevaplama hesaplama komutu.

. /mlfq.py -l 0,150,0:100,50,5 -q 10 -n 3 -i 2 -S -B 50 -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -l 0,150,0:100,50,5:100,50,5 -q 10 -n 3 -i
 2 -S -B 50 -c
Here is the list of inputs:
OPTIONS jobs 3
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 50
OPTIONS ioTime 2
OPTIONS stayAfterIO True
OPTIONS ioBump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime 150 - ioFreq   0
  Job  1: startTime 100 - runTime  50 - ioFreq   5
  Job  2: startTime 100 - runTime  50 - ioFreq   5


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 149 (of 150) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 148 (of 150) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 147 (of 150) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 146 (of 150) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 145 (of 150) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 144 (of 150) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 143 (of 150) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 142 (of 150) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 141 (of 150) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 140 (of 150) ]
[ time 10 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 139 (of 150) ]
[ time 11 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 138 (of 150) ]
[ time 12 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 137 (of 150) ]
[ time 13 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 136 (of 150) ]
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 135 (of 150) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 134 (of 150) ]
[ time 16 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 133 (of 150) ]
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 132 (of 150) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 131 (of 150) ]
[ time 19 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 130 (of 150) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 129 (of 150) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 128 (of 150) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 127 (of 150) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 126 (of 150) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 125 (of 150) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 124 (of 150) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 123 (of 150) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 122 (of 150) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 121 (of 150) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 120 (of 150) ]
[ time 30 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 119 (of 150) ]
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 118 (of 150) ]
[ time 32 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 117 (of 150) ]
[ time 33 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 116 (of 150) ]
[ time 34 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 115 (of 150) ]
[ time 35 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 114 (of 150) ]
[ time 36 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 113 (of 150) ]
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 112 (of 150) ]
[ time 38 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 111 (of 150) ]
[ time 39 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 110 (of 150) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 109 (of 150) ]
[ time 41 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 108 (of 150) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 107 (of 150) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 106 (of 150) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 105 (of 150) ]
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 104 (of 150) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 103 (of 150) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 102 (of 150) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 101 (of 150) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 100 (of 150) ]
[ time 50 ] BOOST ( every 50 )
[ time 50 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 99 (of 150) ]
[ time 51 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 98 (of 150) ]
[ time 52 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 97 (of 150) ]
[ time 53 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 96 (of 150) ]
[ time 54 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 95 (of 150) ]
[ time 55 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 94 (of 150) ]
[ time 56 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 93 (of 150) ]
[ time 57 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 92 (of 150) ]
[ time 58 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 91 (of 150) ]
[ time 59 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 90 (of 150) ]
[ time 60 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 89 (of 150) ]
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 59 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 90 (of 150) ]
[ time 60 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 89 (of 150) ]
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 88 (of 150) ]
[ time 62 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 87 (of 150) ]
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 86 (of 150) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 85 (of 150) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 84 (of 150) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 83 (of 150) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 82 (of 150) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 81 (of 150) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 80 (of 150) ]
[ time 70 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 79 (of 150) ]
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 78 (of 150) ]
[ time 72 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 77 (of 150) ]
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 76 (of 150) ]
[ time 74 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 75 (of 150) ]
[ time 75 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 74 (of 150) ]
[ time 76 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 73 (of 150) ]
[ time 77 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 72 (of 150) ]
[ time 78 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 71 (of 150) ]
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 70 (of 150) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 69 (of 150) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 68 (of 150) ]
[ time 82 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 67 (of 150) ]
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 66 (of 150) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 65 (of 150) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 64 (of 150) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 63 (of 150) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 62 (of 150) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 61 (of 150) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 60 (of 150) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 59 (of 150) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 58 (of 150) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 57 (of 150) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 56 (of 150) ]
[ time 94 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 55 (of 150) ]
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 54 (of 150) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 53 (of 150) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 52 (of 150) ]
[ time 98 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 51 (of 150) ]
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 50 (of 150) ]
[ time 100 ] BOOST ( every 50 )
[ time 100 ] JOB BEGINS by JOB 1
[ time 100 ] JOB BEGINS by JOB 2
[ time 100 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 49 (of 150) ]
[ time 101 ] Run JOB 1 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 49 (of 50) ]
[ time 102 ] Run JOB 2 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 49 (of 50) ]
```

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fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 102 ] Run JOB 2 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 49 (of 50) ]
[ time 103 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 48 (of 150) ]
[ time 104 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 47 (of 150) ]
[ time 105 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 46 (of 150) ]
[ time 106 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 45 (of 150) ]
[ time 107 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 44 (of 150) ]
[ time 108 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 43 (of 150) ]
[ time 109 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 42 (of 150) ]
[ time 110 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 41 (of 150) ]
[ time 111 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 40 (of 150) ]
[ time 112 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 39 (of 150) ]
[ time 113 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 48 (of 50) ]
[ time 114 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 47 (of 50) ]
[ time 115 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 46 (of 50) ]
[ time 116 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 45 (of 50) ]
[ time 117 ] IO_START by JOB 1
IO DONE
[ time 117 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 48 (of 50) ]
[ time 118 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 47 (of 50) ]
[ time 119 ] IO_DONE by JOB 1
[ time 119 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 46 (of 50) ]
[ time 120 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 45 (of 50) ]
[ time 121 ] IO_START by JOB 2
IO DONE
[ time 121 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 44 (of 50) ]
[ time 122 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 43 (of 50) ]
[ time 123 ] IO_DONE by JOB 2
[ time 123 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 42 (of 50) ]
[ time 124 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 41 (of 50) ]
[ time 125 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 40 (of 50) ]
[ time 126 ] IO_START by JOB 1
IO DONE
[ time 126 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 44 (of 50) ]
[ time 127 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 43 (of 50) ]
[ time 128 ] IO_DONE by JOB 1
[ time 128 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 42 (of 50) ]
[ time 129 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 41 (of 50) ]
[ time 130 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 40 (of 50) ]
[ time 131 ] IO_START by JOB 2
IO DONE
[ time 131 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 132 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 133 ] IO_DONE by JOB 2
[ time 133 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 134 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 135 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 136 ] IO_START by JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 136 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 137 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 138 ] IO_DONE by JOB 1
[ time 138 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 139 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 140 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 141 ] IO_START by JOB 2
IO_DONE
[ time 141 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 34 (of 50) ]
[ time 142 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 33 (of 50) ]
[ time 143 ] IO_DONE by JOB 2
[ time 143 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 32 (of 50) ]
[ time 144 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 31 (of 50) ]
[ time 145 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 30 (of 50) ]
[ time 146 ] IO_START by JOB 1
IO_DONE
[ time 146 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 34 (of 50) ]
[ time 147 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 33 (of 50) ]
[ time 148 ] IO_DONE by JOB 1
[ time 148 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 32 (of 50) ]
[ time 149 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 31 (of 50) ]
[ time 150 ] BOOST ( every 50 )
[ time 150 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 38 (of 150) ]
[ time 151 ] Run JOB 2 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 30 (of 50) ]
[ time 152 ] IO_START by JOB 2
IO_DONE
[ time 152 ] Run JOB 1 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 29 (of 50) ]
[ time 153 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 37 (of 150) ]
[ time 154 ] IO_DONE by JOB 2
[ time 154 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 36 (of 150) ]
[ time 155 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 35 (of 150) ]
[ time 156 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 34 (of 150) ]
[ time 157 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 33 (of 150) ]
[ time 158 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 32 (of 150) ]
[ time 159 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 31 (of 150) ]
[ time 160 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 30 (of 150) ]
[ time 161 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 29 (of 150) ]
[ time 162 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 28 (of 150) ]
[ time 163 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 28 (of 50) ]
[ time 164 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 27 (of 50) ]
[ time 165 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 26 (of 50) ]
[ time 166 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 25 (of 50) ]
[ time 167 ] IO_START by JOB 1
IO_DONE
[ time 167 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 168 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 28 (of 50) ]
[ time 169 ] IO_DONE by JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 169 ] IO_DONE by JOB 1
[ time 169 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 27 (of 50) ]
[ time 170 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 26 (of 50) ]
[ time 171 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 25 (of 50) ]
[ time 172 ] IO_START by JOB 2
IO_DONE
[ time 172 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 24 (of 50) ]
[ time 173 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 23 (of 50) ]
[ time 174 ] IO_DONE by JOB 2
[ time 174 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 22 (of 50) ]
[ time 175 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 21 (of 50) ]
[ time 176 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 20 (of 50) ]
[ time 177 ] IO_START by JOB 1
IO_DONE
[ time 177 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 24 (of 50) ]
[ time 178 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 23 (of 50) ]
[ time 179 ] IO_DONE by JOB 1
[ time 179 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 22 (of 50) ]
[ time 180 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 21 (of 50) ]
[ time 181 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 20 (of 50) ]
[ time 182 ] IO_START by JOB 2
IO_DONE
[ time 182 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 183 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 184 ] IO_DONE by JOB 2
[ time 184 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 185 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 186 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 187 ] IO_START by JOB 1
IO_DONE
[ time 187 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 188 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 189 ] IO_DONE by JOB 1
[ time 189 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 190 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 191 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 192 ] IO_START by JOB 2
IO_DONE
[ time 192 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 14 (of 50) ]
[ time 193 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 13 (of 50) ]
[ time 194 ] IO_DONE by JOB 2
[ time 194 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 12 (of 50) ]
[ time 195 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 11 (of 50) ]
[ time 196 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 10 (of 50) ]
[ time 197 ] IO_START by JOB 1
IO_DONE
[ time 197 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 14 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 220 ] IO_DONE by JOB 1
[ time 220 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 221 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 222 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 223 ] IO_START by JOB 2
IO_DONE
[ time 223 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 4 (of 50) ]
[ time 224 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 3 (of 50) ]
[ time 225 ] IO_DONE by JOB 2
[ time 225 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 2 (of 50) ]
[ time 226 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 1 (of 50) ]
[ time 227 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 0 (of 50) ]
[ time 228 ] FINISHED JOB 1
[ time 228 ] Run JOB 2 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 4 (of 50) ]
[ time 229 ] Run JOB 2 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 3 (of 50) ]
[ time 230 ] Run JOB 2 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 2 (of 50) ]
[ time 231 ] Run JOB 2 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 1 (of 50) ]
[ time 232 ] Run JOB 2 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 0 (of 50) ]
[ time 233 ] FINISHED JOB 2
[ time 233 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 16 (of 150) ]
[ time 234 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 15 (of 150) ]
[ time 235 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 14 (of 150) ]
[ time 236 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 13 (of 150) ]
[ time 237 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 12 (of 150) ]
[ time 238 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 11 (of 150) ]
[ time 239 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 10 (of 150) ]
[ time 240 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 9 (of 150) ]
[ time 241 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 8 (of 150) ]
[ time 242 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 7 (of 150) ]
[ time 243 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 6 (of 150) ]
[ time 244 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 5 (of 150) ]
[ time 245 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 4 (of 150) ]
[ time 246 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 3 (of 150) ]
[ time 247 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 2 (of 150) ]
[ time 248 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 1 (of 150) ]
[ time 249 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 0 (of 150) ]
[ time 250 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 250
  Job  1: startTime 100 - response   1 - turnaround 128
  Job  2: startTime 180 - response   2 - turnaround 133

  Avg  2: startTime n/a - response 1.00 - turnaround 170.33

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

//Şekil 8.6

Simulatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ oluşturur ve her 10 ms 'lik zaman dilimine sahiptir. Iki iş oluşturur. İş 0, 0 zamanda başlar, toplam 50 ms CPU süresine ihtiyaç duyar ve hiç G/Ç yayınlamaz; İş 1, 20 ms'de başlar, tamamlanması için 50 ms CPU süresine ihtiyaç duyar ve ayrıca 5 G/Ç yayınlar.

-n MLFQ kuyruk sayısı =3
-j listedeki iş sayısı=2
-q zaman dilim uzunluğu= 10
-i bir G/Ç ne kadar sürmesi gerektiği(sabit)= 1
-S G/Ç verirken sıfırlanır ve aynı öncelik seviyesinde kalır
-c cevaplama hesaplama komutu.

. /mlfq.py -l 0,50,0:20,50,5 -q 10 -n 3 -i 1 -S -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -l 0,50,0:20,50,5 -q 10 -n 3 -i 1 -S -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 1
OPTIONS stayAfterIO True
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime  50 - ioFreq   0
  Job  1: startTime  20 - runTime  50 - ioFreq   5


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 49 (of 50) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 48 (of 50) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 47 (of 50) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 46 (of 50) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 45 (of 50) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 44 (of 50) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 43 (of 50) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 42 (of 50) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 41 (of 50) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 40 (of 50) ]
[ time 10 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 11 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 12 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 13 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 14 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 15 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 34 (of 50) ]
[ time 16 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 33 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 17 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 32 (of 50) ]
[ time 18 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 31 (of 50) ]
[ time 19 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 30 (of 50) ]
[ time 20 ] JOB BEGINS by JOB 1
[ time 20 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 49 (of 50) ]
[ time 21 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 48 (of 50) ]
[ time 22 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 47 (of 50) ]
[ time 23 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 46 (of 50) ]
[ time 24 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 45 (of 50) ]
[ time 25 ] IO_START by JOB 1
IO DONE
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 26 ] IO_DONE by JOB 1
[ time 26 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 44 (of 50) ]
[ time 27 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 43 (of 50) ]
[ time 28 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 42 (of 50) ]
[ time 29 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 41 (of 50) ]
[ time 30 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 40 (of 50) ]
[ time 31 ] IO_START by JOB 1
IO DONE
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 50) ]
[ time 32 ] IO_DONE by JOB 1
[ time 32 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 33 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 34 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 35 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 36 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 37 ] IO_START by JOB 1
IO DONE
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 50) ]
[ time 38 ] IO_DONE by JOB 1
[ time 38 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 34 (of 50) ]
[ time 39 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 33 (of 50) ]
[ time 40 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 32 (of 50) ]
[ time 41 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 31 (of 50) ]
[ time 42 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 30 (of 50) ]
[ time 43 ] IO_START by JOB 1
IO DONE
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 50) ]
[ time 44 ] IO_DONE by JOB 1
[ time 44 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 45 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 28 (of 50) ]
[ time 46 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 27 (of 50) ]
[ time 47 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 26 (of 50) ]
[ time 48 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 25 (of 50) ]
[ time 49 ] IO_START by JOB 1
IO DONE
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 49 ] IO_START by JOB 1
IO DONE
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 50) ]
[ time 50 ] IO_DONE by JOB 1
[ time 50 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 24 (of 50) ]
[ time 51 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 23 (of 50) ]
[ time 52 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 22 (of 50) ]
[ time 53 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 21 (of 50) ]
[ time 54 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 20 (of 50) ]
[ time 55 ] IO_START by JOB 1
IO DONE
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 50) ]
[ time 56 ] IO_DONE by JOB 1
[ time 56 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 57 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 58 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 59 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 60 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 61 ] IO_START by JOB 1
IO DONE
[ time 61 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 50) ]
[ time 62 ] IO_DONE by JOB 1
[ time 62 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 14 (of 50) ]
[ time 63 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 13 (of 50) ]
[ time 64 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 12 (of 50) ]
[ time 65 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 11 (of 50) ]
[ time 66 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 10 (of 50) ]
[ time 67 ] IO_START by JOB 1
IO DONE
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 50) ]
[ time 68 ] IO_DONE by JOB 1
[ time 68 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 69 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 70 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 71 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 72 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 73 ] IO_START by JOB 1
IO DONE
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 50) ]
[ time 74 ] IO_DONE by JOB 1
[ time 74 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 4 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 3 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 2 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 1 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 0 (of 50) ]
[ time 79 ] FINISHED JOB 1
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File Edit View Search Terminal Help
[ time 68 ] IO_DONE by JOB 1
[ time 68 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 69 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 70 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 71 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 72 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 73 ] IO_START by JOB 1
IO DONE
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 50) ]
[ time 74 ] IO_DONE by JOB 1
[ time 74 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 4 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 3 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 2 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 1 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 0 (of 50) ]
[ time 79 ] FINISHED JOB 1
[ time 79 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 50) ]
[ time 80 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 81 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 82 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 83 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 50) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 50) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 50) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 50) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 50) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 93 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 94 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 95 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 50) ]
[ time 96 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 50) ]
[ time 97 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 50) ]
[ time 98 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 50) ]
[ time 99 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 50) ]
[ time 100 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 100
  Job  1: startTime  20 - response   0 - turnaround  30

  Avg  1: startTime n/a - response 0.00 - turnaround 79.50

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

//Şekil 8.7

Simulatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ oluşturur ve her 10 ms 'lik zaman dilimine sahiptir. Iki iş oluşturur. İş 0, 0 zamanda başlar, toplam 20 ms CPU süresine ihtiyaç duyar ve hiç G/Ç yayınlamaz; İş 1, 0 ms'de başlar, tamamlanması için 30 ms CPU süresine ihtiyaç duyar ve ayrıca hiç G/Ç yayınlamaz.

-n MLFQ kuyruk sayısı =3
-j listedeki iş sayısı=2
-q zaman dilim uzunluğu= 10
-Q kuyruk seviyesi başına zaman dilimi uzunluğu, x, y,z olarak belirtilir; burda x en yüksek öncelik için kuantum uzunluğu sırası, y bir sonraki en yüksek sıra ve bu şekilde devam eder.

-c cevaplama hesaplama komutu.

. /mlfq.py -l 0,20,0:0,30,0 -Q 10,20,40 -n 3 -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -l 0,20,0:0,30,0 -Q 10,20,40 -n 3 -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is  10
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  20
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  40
OPTIONS boost 0
OPTIONS ioTime 5
OPTIONS stayAfterIO False
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime  20 - ioFreq   0
  Job  1: startTime   0 - runTime  30 - ioFreq   0


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] JOB BEGINS by JOB 1
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 19 (of 20) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 18 (of 20) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 17 (of 20) ]
[ time 3 ] Run JOB 0 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 16 (of 20) ]
[ time 4 ] Run JOB 0 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 15 (of 20) ]
[ time 5 ] Run JOB 0 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 14 (of 20) ]
[ time 6 ] Run JOB 0 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 13 (of 20) ]
[ time 7 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 12 (of 20) ]
[ time 8 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 11 (of 20) ]
[ time 9 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 10 (of 20) ]
[ time 10 ] Run JOB 1 at PRIORITY 2 [ TICKS 9 ALLOT 1 TIME 29 (of 30) ]
[ time 11 ] Run JOB 1 at PRIORITY 2 [ TICKS 8 ALLOT 1 TIME 28 (of 30) ]
[ time 12 ] Run JOB 1 at PRIORITY 2 [ TICKS 7 ALLOT 1 TIME 27 (of 30) ]
[ time 13 ] Run JOB 1 at PRIORITY 2 [ TICKS 6 ALLOT 1 TIME 26 (of 30) ]
[ time 14 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 25 (of 30) ]
[ time 15 ] Run JOB 1 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 24 (of 30) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
File  Edit  View  Search  Terminal  Help
[ time 14 ] Run JOB 1 at PRIORITY 2 [ TICKS 5 ALLOT 1 TIME 25 (of 30) ]
[ time 15 ] Run JOB 1 at PRIORITY 2 [ TICKS 4 ALLOT 1 TIME 24 (of 30) ]
[ time 16 ] Run JOB 1 at PRIORITY 2 [ TICKS 3 ALLOT 1 TIME 23 (of 30) ]
[ time 17 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 22 (of 30) ]
[ time 18 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 21 (of 30) ]
[ time 19 ] Run JOB 1 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 20 (of 30) ]
[ time 20 ] Run JOB 0 at PRIORITY 1 [ TICKS 19 ALLOT 1 TIME 9 (of 20) ]
[ time 21 ] Run JOB 0 at PRIORITY 1 [ TICKS 18 ALLOT 1 TIME 8 (of 20) ]
[ time 22 ] Run JOB 0 at PRIORITY 1 [ TICKS 17 ALLOT 1 TIME 7 (of 20) ]
[ time 23 ] Run JOB 0 at PRIORITY 1 [ TICKS 16 ALLOT 1 TIME 6 (of 20) ]
[ time 24 ] Run JOB 0 at PRIORITY 1 [ TICKS 15 ALLOT 1 TIME 5 (of 20) ]
[ time 25 ] Run JOB 0 at PRIORITY 1 [ TICKS 14 ALLOT 1 TIME 4 (of 20) ]
[ time 26 ] Run JOB 0 at PRIORITY 1 [ TICKS 13 ALLOT 1 TIME 3 (of 20) ]
[ time 27 ] Run JOB 0 at PRIORITY 1 [ TICKS 12 ALLOT 1 TIME 2 (of 20) ]
[ time 28 ] Run JOB 0 at PRIORITY 1 [ TICKS 11 ALLOT 1 TIME 1 (of 20) ]
[ time 29 ] Run JOB 0 at PRIORITY 1 [ TICKS 10 ALLOT 1 TIME 0 (of 20) ]
[ time 30 ] FINISHED JOB 0
[ time 30 ] Run JOB 1 at PRIORITY 1 [ TICKS 19 ALLOT 1 TIME 19 (of 30) ]
[ time 31 ] Run JOB 1 at PRIORITY 1 [ TICKS 18 ALLOT 1 TIME 18 (of 30) ]
[ time 32 ] Run JOB 1 at PRIORITY 1 [ TICKS 17 ALLOT 1 TIME 17 (of 30) ]
[ time 33 ] Run JOB 1 at PRIORITY 1 [ TICKS 16 ALLOT 1 TIME 16 (of 30) ]
[ time 34 ] Run JOB 1 at PRIORITY 1 [ TICKS 15 ALLOT 1 TIME 15 (of 30) ]
[ time 35 ] Run JOB 1 at PRIORITY 1 [ TICKS 14 ALLOT 1 TIME 14 (of 30) ]
[ time 36 ] Run JOB 1 at PRIORITY 1 [ TICKS 13 ALLOT 1 TIME 13 (of 30) ]
[ time 37 ] Run JOB 1 at PRIORITY 1 [ TICKS 12 ALLOT 1 TIME 12 (of 30) ]
[ time 38 ] Run JOB 1 at PRIORITY 1 [ TICKS 11 ALLOT 1 TIME 11 (of 30) ]
[ time 39 ] Run JOB 1 at PRIORITY 1 [ TICKS 10 ALLOT 1 TIME 10 (of 30) ]
[ time 40 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 9 (of 30) ]
[ time 41 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 8 (of 30) ]
[ time 42 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 7 (of 30) ]
[ time 43 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 6 (of 30) ]
[ time 44 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 5 (of 30) ]
[ time 45 ] Run JOB 1 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 4 (of 30) ]
[ time 46 ] Run JOB 1 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 3 (of 30) ]
[ time 47 ] Run JOB 1 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 2 (of 30) ]
[ time 48 ] Run JOB 1 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 1 (of 30) ]
[ time 49 ] Run JOB 1 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 0 (of 30) ]
[ time 50 ] FINISHED JOB 1

Final statistics:
  Job  0: startime   0 - response   0 - turnaround  30
  Job  1: startime   0 - response  10 - turnaround  50

  Avg  1: startime n/a - response 5.00 - turnaround 40.00

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

3. Zamanlayıcı parametrelerini tıpkı bir round-robin zamanlayıcı gibi davranacak şekilde nasıl yapılandırırsınız?

   Çoklu kuyruklarda MLFQ'yu, en yüksek önceliğe sahip ilk iş daha düşük önceliğe indiğinde, takip eden diğer tüm işlerin de aynı yinelemede daha düşük kuyruğa taşınacağı şekilde yapılandırmamız gerekir.

4. İki iş ve zamanlayıcı parametresi içeren bir iş yükü oluşturun, böylece bir iş zamanlayıcıyı oynamak ve belirli bir zaman aralığında CPU'nun %99'nu elde etmek için eski Kural 4a ve 4b'den (-S bayrağıyla etkinleştirildi) yararlanılır.

   Simülatörü bu şekilde çalıştırmak üç seviyeli bir MLFQ olşturur ve her 3 ms'lik zaman dilimine sahiptir. Iki iş oluşturur. Iş 0, 0 zamanda başlar, toplam 5 ms çalışır ve 100 G/Ç yayınlar. Iş 1, 3 ms'de başlar, tamamlanması için 100 ms CPU süresine ihtiyaç duyar ve 2 G/Ç yayınlar. G/Ç süresi 0 ms ye sürer. Aynı öncelik seviyesinde kalır.

   -n MLFQ'nun kuyruk sayısı =3
   -j listedeki iş sayısı =2
   -q zaman dilimi uzunluğu = 3
   -i G/Ç süresi ne kadar sürmesi gerektiği
   -S G/Ç aynı öncelik seviyesinde kalmasını sağlar
   -c cevapları hesaplama komutu

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -l 0,5,0:3,100,2 -q 3 -i 0 -S -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 3
OPTIONS allotments for queue  2 is   1
OPTIONS quantum length for queue  2 is   3
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is   3
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is   3
OPTIONS boost 0
OPTIONS ioTime 0
OPTIONS stayAfterIO True
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job List:
  Job  0: startTime   0 - runTime   5 - ioFreq   0
  Job  1: startTime   3 - runTime 100 - ioFreq   2


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] Run JOB 0 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 4 (of 5) ]
[ time 1 ] Run JOB 0 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 3 (of 5) ]
[ time 2 ] Run JOB 0 at PRIORITY 2 [ TICKS 0 ALLOT 1 TIME 2 (of 5) ]
[ time 3 ] JOB BEGINS by JOB 1
[ time 3 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 99 (of 100) ]
[ time 4 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 98 (of 100) ]
[ time 5 ] IO_START by JOB 1
IO DONE
[ time 5 ] IO_DONE by JOB 1
[ time 5 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 97 (of 100) ]
[ time 6 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 96 (of 100) ]
[ time 7 ] IO_START by JOB 1
IO DONE
[ time 7 ] IO_DONE by JOB 1
[ time 7 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 95 (of 100) ]
[ time 8 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 94 (of 100) ]
[ time 9 ] IO_START by JOB 1
IO DONE
[ time 9 ] IO_DONE by JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 8 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 94 (of 100) ]
[ time 9 ] IO_START by JOB 1
IO DONE
[ time 9 ] IO_DONE by JOB 1
[ time 9 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 93 (of 100) ]
[ time 10 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 92 (of 100) ]
[ time 11 ] IO_START by JOB 1
IO DONE
[ time 11 ] IO_DONE by JOB 1
[ time 11 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 91 (of 100) ]
[ time 12 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 90 (of 100) ]
[ time 13 ] IO_START by JOB 1
IO DONE
[ time 13 ] IO_DONE by JOB 1
[ time 13 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 89 (of 100) ]
[ time 14 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 88 (of 100) ]
[ time 15 ] IO_START by JOB 1
IO DONE
[ time 15 ] IO_DONE by JOB 1
[ time 15 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 87 (of 100) ]
[ time 16 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 86 (of 100) ]
[ time 17 ] IO_START by JOB 1
IO DONE
[ time 17 ] IO_DONE by JOB 1
[ time 17 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 85 (of 100) ]
[ time 18 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 84 (of 100) ]
[ time 19 ] IO_START by JOB 1
IO DONE
[ time 19 ] IO_DONE by JOB 1
[ time 19 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 83 (of 100) ]
[ time 20 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 82 (of 100) ]
[ time 21 ] IO_START by JOB 1
IO DONE
[ time 21 ] IO_DONE by JOB 1
[ time 21 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 81 (of 100) ]
[ time 22 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 80 (of 100) ]
[ time 23 ] IO_START by JOB 1
IO DONE
[ time 23 ] IO_DONE by JOB 1
[ time 23 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 79 (of 100) ]
[ time 24 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 78 (of 100) ]
[ time 25 ] IO_START by JOB 1
IO DONE
[ time 25 ] IO_DONE by JOB 1
[ time 25 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 77 (of 100) ]
[ time 26 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 76 (of 100) ]
[ time 27 ] IO_START by JOB 1
IO DONE
[ time 27 ] IO_DONE by JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 26 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 76 (of 100) ]
[ time 27 ] IO_START by JOB 1
IO DONE
[ time 27 ] IO_DONE by JOB 1
[ time 27 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 75 (of 100) ]
[ time 28 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 74 (of 100) ]
[ time 29 ] IO_START by JOB 1
IO DONE
[ time 29 ] IO_DONE by JOB 1
[ time 29 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 73 (of 100) ]
[ time 30 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 72 (of 100) ]
[ time 31 ] IO_START by JOB 1
IO DONE
[ time 31 ] IO_DONE by JOB 1
[ time 31 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 71 (of 100) ]
[ time 32 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 70 (of 100) ]
[ time 33 ] IO_START by JOB 1
IO DONE
[ time 33 ] IO_DONE by JOB 1
[ time 33 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 69 (of 100) ]
[ time 34 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 68 (of 100) ]
[ time 35 ] IO_START by JOB 1
IO DONE
[ time 35 ] IO_DONE by JOB 1
[ time 35 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 67 (of 100) ]
[ time 36 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 66 (of 100) ]
[ time 37 ] IO_START by JOB 1
IO DONE
[ time 37 ] IO_DONE by JOB 1
[ time 37 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 65 (of 100) ]
[ time 38 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 64 (of 100) ]
[ time 39 ] IO_START by JOB 1
IO DONE
[ time 39 ] IO_DONE by JOB 1
[ time 39 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 63 (of 100) ]
[ time 40 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 62 (of 100) ]
[ time 41 ] IO_START by JOB 1
IO DONE
[ time 41 ] IO_DONE by JOB 1
[ time 41 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 61 (of 100) ]
[ time 42 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 60 (of 100) ]
[ time 43 ] IO_START by JOB 1
IO DONE
[ time 43 ] IO_DONE by JOB 1
[ time 43 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 59 (of 100) ]
[ time 44 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 58 (of 100) ]
[ time 45 ] IO_START by JOB 1
IO DONE
[ time 45 ] IO_DONE by JOB 1
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
IO DONE
[ time 65 ] IO_DONE by JOB 1
[ time 65 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 37 (of 100) ]
[ time 66 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 36 (of 100) ]
[ time 67 ] IO_START by JOB 1
IO DONE
[ time 67 ] IO_DONE by JOB 1
[ time 67 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 35 (of 100) ]
[ time 68 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 34 (of 100) ]
[ time 69 ] IO_START by JOB 1
IO DONE
[ time 69 ] IO_DONE by JOB 1
[ time 69 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 33 (of 100) ]
[ time 70 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 32 (of 100) ]
[ time 71 ] IO_START by JOB 1
IO DONE
[ time 71 ] IO_DONE by JOB 1
[ time 71 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 31 (of 100) ]
[ time 72 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 30 (of 100) ]
[ time 73 ] IO_START by JOB 1
IO DONE
[ time 73 ] IO_DONE by JOB 1
[ time 73 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 29 (of 100) ]
[ time 74 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 28 (of 100) ]
[ time 75 ] IO_START by JOB 1
IO DONE
[ time 75 ] IO_DONE by JOB 1
[ time 75 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 27 (of 100) ]
[ time 76 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 26 (of 100) ]
[ time 77 ] IO_START by JOB 1
IO DONE
[ time 77 ] IO_DONE by JOB 1
[ time 77 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 25 (of 100) ]
[ time 78 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 24 (of 100) ]
[ time 79 ] IO_START by JOB 1
IO DONE
[ time 79 ] IO_DONE by JOB 1
[ time 79 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 23 (of 100) ]
[ time 80 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 22 (of 100) ]
[ time 81 ] IO_START by JOB 1
IO DONE
[ time 81 ] IO_DONE by JOB 1
[ time 81 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 21 (of 100) ]
[ time 82 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 20 (of 100) ]
[ time 83 ] IO_START by JOB 1
IO DONE
[ time 83 ] IO_DONE by JOB 1
[ time 83 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 19 (of 100) ]
[ time 84 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 18 (of 100) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 88 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 14 (of 100) ]
[ time 89 ] IO_START by JOB 1
IO DONE
[ time 89 ] IO_DONE by JOB 1
[ time 89 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 13 (of 100) ]
[ time 90 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 12 (of 100) ]
[ time 91 ] IO_START by JOB 1
IO DONE
[ time 91 ] IO_DONE by JOB 1
[ time 91 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 11 (of 100) ]
[ time 92 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 10 (of 100) ]
[ time 93 ] IO_START by JOB 1
IO DONE
[ time 93 ] IO_DONE by JOB 1
[ time 93 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 9 (of 100) ]
[ time 94 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 8 (of 100) ]
[ time 95 ] IO_START by JOB 1
IO DONE
[ time 95 ] IO_DONE by JOB 1
[ time 95 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 7 (of 100) ]
[ time 96 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 6 (of 100) ]
[ time 97 ] IO_START by JOB 1
IO DONE
[ time 97 ] IO_DONE by JOB 1
[ time 97 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 5 (of 100) ]
[ time 98 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 4 (of 100) ]
[ time 99 ] IO_START by JOB 1
IO DONE
[ time 99 ] IO_DONE by JOB 1
[ time 99 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 3 (of 100) ]
[ time 100 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 2 (of 100) ]
[ time 101 ] IO_START by JOB 1
IO DONE
[ time 101 ] IO_DONE by JOB 1
[ time 101 ] Run JOB 1 at PRIORITY 2 [ TICKS 2 ALLOT 1 TIME 1 (of 100) ]
[ time 102 ] Run JOB 1 at PRIORITY 2 [ TICKS 1 ALLOT 1 TIME 0 (of 100) ]
[ time 103 ] FINISHED JOB 1
[ time 103 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 1 (of 5) ]
[ time 104 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 0 (of 5) ]
[ time 105 ] FINISHED JOB 0

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround 105
  Job  1: startTime   3 - response   0 - turnaround 100

  Avg  1: startTime n/a - response 0.00 - turnaround 102.50

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

Iş 0 için başlama süresi 0 ms, geri dönüş süresi (turnround) 105 ms'dir.
Iş 1 için başlama süresi 3 ms, geri dönüş süresi (turnround) 100 ms'dir.
Turnround= (105+100)/2= 102.50 ms

5. En yüksek kuyruğunda kuantum uzunluğu 10 ms sahip bir sistem göz önüne alındığında, uzun süredir devam eden (ve potansiyel olarak açlık çeken) tek bir işin CPU'nun en az %5'ini almasını sağlamak için işleri ne sıklıkla en yüksek öncelik seviyesine (-B bayrağıyla) ne sıklıkta yükseltmemiz gerekir?
   Zaman kuantumunun 200 saniye olması gerekir. Uzun süredir devam eden bir iş başlangıçta Q1'de 10s alacaktır. En kötü durumda Q1'in %100 kullanıldığını varsayarsak, işin rütbesi düşecek ve önceliği artırılmadan önce 180 saniye daha beklemek zorunda kalacaktır. Bu, işin zaman adımlarını 10/200=0,05=%5'ini çalıştırmasına izin verecektir.

   -B 200 olmalıdır.

6. Planlamada ortaya çıkan bir soru, G/Ç 'yi yeni bitirmiş bir işin kuyruğun hangi ucuna ekleyeceğidir; -I bayrağı, bu zamanlama simülatörü için bu davranışı değiştirir. Bazı iş yükleriyle oynayın ve bu bayrağın etkisini görüp görmeyeceğine bakın.

   Simülatörü bu şekilde çalıştırmak iki seviyeli bir MLFQ oluşturur ve her 10 ms'lik zaman dilimine sahiptir. İki iş oluşturur. İş 0, 0 zamanında başlar, toplam 50 ms çalışır ve hiç G/Ç yayınlamaz. Iş 1, 0 zamanında başlar 50 ms çalışır ve 11 G/Ç yayınlar. G/Ç süresi 1 ms sürer. Aynı öncelik seviyesinde kalır.

   -n MLFQ'nun kuyruk sayısı=2
   -j listedeki iş sayısı=2
   -q zaman dilimi uzunluğu
   -l işin ne sıklıkla G/Ç isteği gönderdiğidir
   -i G/Ç'ın ne kadar sürmesi gerektiği(sabit)
   -S aynı öncelik seviyesinde kalması

. /mlfq.py -n 2 -q 10 -l 0,50,0:0,50,11 -i 1 -S -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$ ./mlfq.py -n 2 -q 10 -l 0,50,0:0,50,11 -l 1
-S -c
Here is the list of inputs:
OPTIONS jobs 2
OPTIONS queues 2
OPTIONS allotments for queue  1 is   1
OPTIONS quantum length for queue  1 is  10
OPTIONS allotments for queue  0 is   1
OPTIONS quantum length for queue  0 is  10
OPTIONS boost 0
OPTIONS ioTime 1
OPTIONS stayAfterIO True
OPTIONS iobump False


For each job, three defining characteristics are given:
  startTime : at what time does the job enter the system
  runTime   : the total CPU time needed by the job to finish
  ioFreq    : every ioFreq time units, the job issues an I/O
              (the I/O takes ioTime units to complete)

Job list:
  Job  0: startTime   0 - runTime  50 - ioFreq   0
  Job  1: startTime   0 - runTime  50 - ioFreq  11


Execution Trace:

[ time 0 ] JOB BEGINS by JOB 0
[ time 0 ] JOB BEGINS by JOB 1
[ time 0 ] Run JOB 0 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 49 (of 50) ]
[ time 1 ] Run JOB 0 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 48 (of 50) ]
[ time 2 ] Run JOB 0 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 47 (of 50) ]
[ time 3 ] Run JOB 0 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 46 (of 50) ]
[ time 4 ] Run JOB 0 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 45 (of 50) ]
[ time 5 ] Run JOB 0 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 44 (of 50) ]
[ time 6 ] Run JOB 0 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 43 (of 50) ]
[ time 7 ] Run JOB 0 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 42 (of 50) ]
[ time 8 ] Run JOB 0 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 41 (of 50) ]
[ time 9 ] Run JOB 0 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 40 (of 50) ]
[ time 10 ] Run JOB 1 at PRIORITY 1 [ TICKS 9 ALLOT 1 TIME 49 (of 50) ]
[ time 11 ] Run JOB 1 at PRIORITY 1 [ TICKS 8 ALLOT 1 TIME 48 (of 50) ]
[ time 12 ] Run JOB 1 at PRIORITY 1 [ TICKS 7 ALLOT 1 TIME 47 (of 50) ]
[ time 13 ] Run JOB 1 at PRIORITY 1 [ TICKS 6 ALLOT 1 TIME 46 (of 50) ]
[ time 14 ] Run JOB 1 at PRIORITY 1 [ TICKS 5 ALLOT 1 TIME 45 (of 50) ]
[ time 15 ] Run JOB 1 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 44 (of 50) ]
[ time 16 ] Run JOB 1 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 43 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 17 ] Run JOB 1 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 42 (of 50) ]
[ time 18 ] Run JOB 1 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 41 (of 50) ]
[ time 19 ] Run JOB 1 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 40 (of 50) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 50) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 50) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 50) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 50) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 50) ]
[ time 30 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 31 ] IO_START by JOB 1
IO DONE
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 32 ] IO_DONE by JOB 1
[ time 32 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 50) ]
[ time 33 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 50) ]
[ time 34 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 50) ]
[ time 35 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 50) ]
[ time 36 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 50) ]
[ time 37 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 50) ]
[ time 38 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 50) ]
[ time 39 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 50) ]
[ time 40 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 50) ]
[ time 41 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 38 (of 50) ]
[ time 42 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 37 (of 50) ]
[ time 43 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 36 (of 50) ]
[ time 44 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 35 (of 50) ]
[ time 45 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 34 (of 50) ]
[ time 46 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 33 (of 50) ]
[ time 47 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 32 (of 50) ]
[ time 48 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 31 (of 50) ]
[ time 49 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 30 (of 50) ]
[ time 50 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 29 (of 50) ]
[ time 51 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 52 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 53 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 54 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 55 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 56 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 50) ]
[ time 57 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 50) ]
[ time 58 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 50) ]
[ time 59 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 50) ]
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 50) ]
[ time 61 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 28 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 60 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 50) ]
[ time 61 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 28 (of 50) ]
[ time 62 ] IO_START by JOB 1
IO DONE
[ time 62 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 63 ] IO_DONE by JOB 1
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 50) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 50) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 50) ]
[ time 70 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 50) ]
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 50) ]
[ time 72 ] FINISHED JOB 0
[ time 72 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 27 (of 50) ]
[ time 73 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 26 (of 50) ]
[ time 74 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 25 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 24 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 23 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 22 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 21 (of 50) ]
[ time 79 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 20 (of 50) ]
[ time 80 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 19 (of 50) ]
[ time 81 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 18 (of 50) ]
[ time 82 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 17 (of 50) ]
[ time 83 ] IO_START by JOB 1
IO DONE
[ time 83 ] IDLE
[ time 84 ] IO_DONE by JOB 1
[ time 84 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 16 (of 50) ]
[ time 85 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 15 (of 50) ]
[ time 86 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 14 (of 50) ]
[ time 87 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 13 (of 50) ]
[ time 88 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 12 (of 50) ]
[ time 89 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 11 (of 50) ]
[ time 90 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 10 (of 50) ]
[ time 91 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 9 (of 50) ]
[ time 92 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 8 (of 50) ]
[ time 93 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 7 (of 50) ]
[ time 94 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 6 (of 50) ]
[ time 95 ] IO_START by JOB 1
IO DONE
[ time 95 ] IDLE
[ time 96 ] IO_DONE by JOB 1
[ time 96 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 5 (of 50) ]
[ time 97 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 4 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 50) ]
[ time 72 ] FINISHED JOB 0
[ time 72 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 27 (of 50) ]
[ time 73 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 26 (of 50) ]
[ time 74 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 25 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 24 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 23 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 22 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 21 (of 50) ]
[ time 79 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 20 (of 50) ]
[ time 80 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 19 (of 50) ]
[ time 81 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 18 (of 50) ]
[ time 82 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 17 (of 50) ]
[ time 83 ] IO_START by JOB 1
IO DONE
[ time 83 ] IDLE
[ time 84 ] IO_DONE by JOB 1
[ time 84 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 16 (of 50) ]
[ time 85 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 15 (of 50) ]
[ time 86 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 14 (of 50) ]
[ time 87 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 13 (of 50) ]
[ time 88 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 12 (of 50) ]
[ time 89 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 11 (of 50) ]
[ time 90 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 10 (of 50) ]
[ time 91 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 9 (of 50) ]
[ time 92 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 8 (of 50) ]
[ time 93 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 7 (of 50) ]
[ time 94 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 6 (of 50) ]
[ time 95 ] IO_START by JOB 1
IO DONE
[ time 95 ] IDLE
[ time 96 ] IO_DONE by JOB 1
[ time 96 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 5 (of 50) ]
[ time 97 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 4 (of 50) ]
[ time 98 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 3 (of 50) ]
[ time 99 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 2 (of 50) ]
[ time 100 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 1 (of 50) ]
[ time 101 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 0 (of 50) ]
[ time 102 ] FINISHED JOB 1

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround  72
  Job  1: startTime   0 - response  10 - turnaround 102

  Avg  1: startTime n/a - response 5.00 - turnaround 87.00

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

Iş 0 için başlama zamanı 0 ms , yanıt süresi 0 ms, geri dönüş süresi(turnround) 72 ms
Iş 1 için başlama zamanı 0 ms, yanıt süresi 0 ms, geri dönüş süresi(turnround) 102 ms

Turnround = (72+102)/2=87 ms

-I bayrağı eklenmiş şekli:

Simülatörü bu şekilde çalıştırmak iki seviyeli bir MLFQ oluşturur ve her 10 ms'lik zaman dilimine sahiptir. İki iş oluşturur. İş 0, 0 zamanında başlar, toplam 50 ms çalışır ve hiç G/Ç yayınlamaz. Iş 1, 0 zamanında başlar 50 ms çalışır ve 11 G/Ç yayınlar. G/Ç süresi 1 ms sürer. Aynı öncelik seviyesinde kalır.

-n MLFQ'nun kuyruk sayısı=2
-j listedeki iş sayısı=2
-q zaman dilimi uzunluğu
-l işin ne sıklıkla G/Ç isteği gönderdiğidir
-i G/Ç'ın ne kadar sürmesi gerektiği(sabit)
-S aynı öncelik seviyesinde kalması

-I bayrağıyla işlerin kuyruğun önüne taşınmasının geri dönüş süresini etkilediğini görüyoruz

. /mlfq.py -n 2 -q 10 -l 0,50,0:0,50,11 -i 1 -S -c

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 15 ] Run JOB 1 at PRIORITY 1 [ TICKS 4 ALLOT 1 TIME 44 (of 50) ]
[ time 16 ] Run JOB 1 at PRIORITY 1 [ TICKS 3 ALLOT 1 TIME 43 (of 50) ]
[ time 17 ] Run JOB 1 at PRIORITY 1 [ TICKS 2 ALLOT 1 TIME 42 (of 50) ]
[ time 18 ] Run JOB 1 at PRIORITY 1 [ TICKS 1 ALLOT 1 TIME 41 (of 50) ]
[ time 19 ] Run JOB 1 at PRIORITY 1 [ TICKS 0 ALLOT 1 TIME 40 (of 50) ]
[ time 20 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 21 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 38 (of 50) ]
[ time 22 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 37 (of 50) ]
[ time 23 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 36 (of 50) ]
[ time 24 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 35 (of 50) ]
[ time 25 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 34 (of 50) ]
[ time 26 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 33 (of 50) ]
[ time 27 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 32 (of 50) ]
[ time 28 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 31 (of 50) ]
[ time 29 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 30 (of 50) ]
[ time 30 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 39 (of 50) ]
[ time 31 ] IO_START by JOB 1
IO DONE
[ time 31 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 29 (of 50) ]
[ time 32 ] IO_DONE by JOB 1
[ time 32 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 38 (of 50) ]
[ time 33 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 37 (of 50) ]
[ time 34 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 36 (of 50) ]
[ time 35 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 35 (of 50) ]
[ time 36 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 34 (of 50) ]
[ time 37 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 33 (of 50) ]
[ time 38 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 32 (of 50) ]
[ time 39 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 31 (of 50) ]
[ time 40 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 30 (of 50) ]
[ time 41 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 29 (of 50) ]
[ time 42 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 28 (of 50) ]
[ time 43 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 27 (of 50) ]
[ time 44 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 26 (of 50) ]
[ time 45 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 25 (of 50) ]
[ time 46 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 24 (of 50) ]
[ time 47 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 23 (of 50) ]
[ time 48 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 22 (of 50) ]
[ time 49 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 21 (of 50) ]
[ time 50 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 20 (of 50) ]
[ time 51 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 28 (of 50) ]
[ time 52 ] IO_START by JOB 1
IO DONE
[ time 52 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 19 (of 50) ]
[ time 53 ] IO_DONE by JOB 1
[ time 53 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 27 (of 50) ]
[ time 54 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 26 (of 50) ]
[ time 55 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 25 (of 50) ]
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 54 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 26 (of 50) ]
[ time 55 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 25 (of 50) ]
[ time 56 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 24 (of 50) ]
[ time 57 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 23 (of 50) ]
[ time 58 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 22 (of 50) ]
[ time 59 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 21 (of 50) ]
[ time 60 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 20 (of 50) ]
[ time 61 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 19 (of 50) ]
[ time 62 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 18 (of 50) ]
[ time 63 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 18 (of 50) ]
[ time 64 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 17 (of 50) ]
[ time 65 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 16 (of 50) ]
[ time 66 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 15 (of 50) ]
[ time 67 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 14 (of 50) ]
[ time 68 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 13 (of 50) ]
[ time 69 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 12 (of 50) ]
[ time 70 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 11 (of 50) ]
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 50) ]
[ time 72 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 17 (of 50) ]
[ time 73 ] IO_START by JOB 1
IO DONE
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 74 ] IO_DONE by JOB 1
[ time 74 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 16 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 15 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 14 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 13 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 12 (of 50) ]
[ time 79 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 11 (of 50) ]
[ time 80 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 10 (of 50) ]
[ time 81 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 9 (of 50) ]
[ time 82 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 8 (of 50) ]
[ time 83 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 7 (of 50) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 50) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 50) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 50) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 50) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 50) ]
[ time 93 ] FINISHED JOB 0
[ time 93 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 6 (of 50) ]
[ time 94 ] IO_START by JOB 1
IO DONE
[ time 94 ] IDLE
```

```
fatma@ubuntu: ~/Desktop/ostep/ostep-homework/cpu-sched-mlfq
[ time 71 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 10 (of 50) ]
[ time 72 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 17 (of 50) ]
[ time 73 ] IO_START by JOB 1
IO DONE
[ time 73 ] Run JOB 0 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 9 (of 50) ]
[ time 74 ] IO_DONE by JOB 1
[ time 74 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 16 (of 50) ]
[ time 75 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 15 (of 50) ]
[ time 76 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 14 (of 50) ]
[ time 77 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 13 (of 50) ]
[ time 78 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 12 (of 50) ]
[ time 79 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 11 (of 50) ]
[ time 80 ] Run JOB 1 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 10 (of 50) ]
[ time 81 ] Run JOB 1 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 9 (of 50) ]
[ time 82 ] Run JOB 1 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 8 (of 50) ]
[ time 83 ] Run JOB 1 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 7 (of 50) ]
[ time 84 ] Run JOB 0 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 8 (of 50) ]
[ time 85 ] Run JOB 0 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 7 (of 50) ]
[ time 86 ] Run JOB 0 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 6 (of 50) ]
[ time 87 ] Run JOB 0 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 5 (of 50) ]
[ time 88 ] Run JOB 0 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 4 (of 50) ]
[ time 89 ] Run JOB 0 at PRIORITY 0 [ TICKS 3 ALLOT 1 TIME 3 (of 50) ]
[ time 90 ] Run JOB 0 at PRIORITY 0 [ TICKS 2 ALLOT 1 TIME 2 (of 50) ]
[ time 91 ] Run JOB 0 at PRIORITY 0 [ TICKS 1 ALLOT 1 TIME 1 (of 50) ]
[ time 92 ] Run JOB 0 at PRIORITY 0 [ TICKS 0 ALLOT 1 TIME 0 (of 50) ]
[ time 93 ] FINISHED JOB 0
[ time 93 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 6 (of 50) ]
[ time 94 ] IO_START by JOB 1
IO DONE
[ time 94 ] IDLE
[ time 95 ] IO_DONE by JOB 1
[ time 95 ] Run JOB 1 at PRIORITY 0 [ TICKS 9 ALLOT 1 TIME 5 (of 50) ]
[ time 96 ] Run JOB 1 at PRIORITY 0 [ TICKS 8 ALLOT 1 TIME 4 (of 50) ]
[ time 97 ] Run JOB 1 at PRIORITY 0 [ TICKS 7 ALLOT 1 TIME 3 (of 50) ]
[ time 98 ] Run JOB 1 at PRIORITY 0 [ TICKS 6 ALLOT 1 TIME 2 (of 50) ]
[ time 99 ] Run JOB 1 at PRIORITY 0 [ TICKS 5 ALLOT 1 TIME 1 (of 50) ]
[ time 100 ] Run JOB 1 at PRIORITY 0 [ TICKS 4 ALLOT 1 TIME 0 (of 50) ]
[ time 101 ] FINISHED JOB 1

Final statistics:
  Job  0: startTime   0 - response   0 - turnaround  93
  Job  1: startTime   0 - response  10 - turnaround 101

  Avg  1: startTime n/a - response 5.00 - turnaround 97.00

fatma@ubuntu:~/Desktop/ostep/ostep-homework/cpu-sched-mlfq$
```

Iş 0 için başlama zamanı 0 ms, yanıt süresi 0 ms, geri dönüş süresi(turnround) 93 ms
Iş 1 için başlama zamanı 0 ms, yanıt süresi 10ms, geri dönüş süresi(turnround) 101 ms

Turnround = (93+101)/2=97 ms

-I bayrağıyla işlerin kuyruğun önüne taşınmasının geri dönüş süresini etkilediğini görüyoruz